

U.S. Department of Energy
Technical Qualifications

Maintenance Management Topical Area

Self-Study Guide
and
Training-to-Competency Matrices

September 1996

FOR TRAINING USE ONLY

The uncontrolled information contained in this text is **FOR TRAINING USE ONLY**. In no way should it be interpreted that the material contained herein may be substituted for facility procedures or SOPs. When copies of SOPs or procedures are given, they are intended as examples and information only, and the latest revision of the material in question should be obtained for actual use. If you have any questions, contact your supervisor.

READ ME FIRST!

This study guide is designed to bring together information and references related to the topical area of Maintenance Management. This document contains 26 topical competencies in 24 chapters. Each competency has the following sections: Supporting Knowledge and Skills, Self-Study Information, References, Practice Exercises, and Practice Exercise Answers. The Supporting Knowledge and Skills sections lists the applicable knowledge and skill statements that further describe the intent of the competency statements. The Self-Study Information is provided to help you refresh your knowledge of the information you need to know to be qualified in that competency. The References section lists the references for further study and information. The Practice Exercise section provides questions, practice exercise, scenarios, or case studies to assist study for the competency. Finally, the Practice Exercise Answers section provides answers to the Practice Exercise section. Additionally, an appendix provides the Training-to-Competency Matrix listing related courses and other activities that address the competency requirements.

COMPETENCIES - Which ones are mine?

The wording of the competencies found in this study guide may not exactly match those found in your Functional Area Qualification Standard. A number of similar competencies from across six functional areas were consolidated to reduce the bulk and repetition of the material. To identify which of the 26 topical competencies in this Guide match the Maintenance Management related competencies from your Functional Area Qualification Standard, use the matrixes on pages ix, x, xi, and xii.

PLEASE NOTE- Not all Knowledge and Skills items identified in the Functional Area Qualification Standards are addressed in the Topical Area Study Guide. Employees are not required to demonstrate competency to the knowledge and skill level in order to qualify, only to the competency level. Ensure that you refer to your Functional Area Qualification Standards and compare those required Knowledge and Skills to the Knowledge and Skills identified in this Study Guide. The Topical Area Competencies in this self study guide list the applicable Functional Area and identifies the Functional Area Competency as FAC# x.x.

WHAT REFERENCES DO I USE?

References used in this study guide are designed to be used throughout the DOE complex when possible. In some cases it is necessary to use site specific documents to provide information which more fully explains the intended knowledge and skills. For example, if a skill is to complete a report - those reports would be specific for a given site. In these situations a site specific reference will be given. In order to gain the most value from the self-study, when a site specific document is referenced, you should identify your own program/operations/field office specific reference(s) which support the requirements of knowledge and skill statement. In the event that a knowledge or skill is such that the only available references are site specific and would not necessarily change from one site to another, the reference will be identified and will accompany the study guide for your use.

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Competency 1.1

Facility maintenance management personnel (FAC# 1.23) shall demonstrate a working level knowledge of the guidelines for maintaining maintenance facilities, equipment, and tools. 1

Competency 1.2

Electrical systems (FAC# 1.16), Instrumentation and control (FAC# 1.25), and Mechanical maintenance (FAC# 1.27) personnel shall demonstrate a familiarity level knowledge of maintenance management practices related to their specialty areas. ... 15

Competency 1.3

Facility maintenance management (FAC# 1.24) and EH Residents (FAC# 2.16) personnel shall demonstrate a working level knowledge of the application of the different types of maintenance. 16

Competency 1.4

Facility maintenance management (FAC# 1.25) personnel shall demonstrate a working level knowledge of the documentation used for controlling maintenance. 47

Competency 1.5

Facility maintenance management (FAC# 1.26) personnel shall demonstrate a working level knowledge of the requirements for controlling maintenance activities. 61

Competency 1.6

Facility maintenance management (FAC# 1.27) personnel shall demonstrate a working level knowledge of planning, scheduling, and coordination of maintenance activities. 81

Competency 1.7

Facility maintenance management (FAC# 1.28) personnel shall demonstrate a working level knowledge of industrial property management practices as related to stores, spare parts, and essential materials. 103

Competency 1.8

Facility maintenance management (FAC# 1.29) personnel shall demonstrate a working level knowledge of the control and calibration of measuring and test equipment. . . . 113

Competency 1.9

Facility maintenance management (FAC# 1.30) personnel shall demonstrate a working level knowledge of modification work. 129

Competency 1.10

Facility maintenance management (FAC# 1.31) personnel shall demonstrate a working level knowledge of the requirements of post-maintenance testing. 137

Competency 1.11

Facility maintenance management (FAC# 1.32) personnel shall demonstrate a working level knowledge of the requirements for material receipt, inspection, handling, storage, retrieval, and issuance. 147

Competency 1.12

Facility maintenance management (FAC# 1.33) personnel shall demonstrate a working level knowledge of the requirements of maintenance tools and equipment control. . . . 157

Competency 1.13

Facility maintenance management (FAC# 1.34) personnel shall demonstrate a working level knowledge of the requirements for facility condition inspections. 163

Competency 1.14

Facility maintenance management (FAC# 1.35) personnel shall demonstrate a working level knowledge of the requirements for management involvement. 173

Competency 1.15

Facility maintenance management (FAC# 1.36) personnel shall demonstrate a working level knowledge of the requirements of maintenance history. 187

Competency 1.16

Electrical systems (FAC# 4.11), Instrumentation and control (FAC# 4.12), and Mechanical systems (FAC# 4.11) personnel shall demonstrate a familiarity level knowledge of Department of Energy (DOE) maintenance management requirements as defined in DOE Order 4330.4B, Maintenance Management Program. 197

Competency 1.17

Facility maintenance management (FAC# 2.1) personnel shall demonstrate a working level knowledge of the Department of Energy's requirements for facility maintenance management as outlined in DOE Order 4330.4B, Maintenance Management Program. 198

Competency 1.18

Facility maintenance management (FAC# 4.4) personnel shall demonstrate the ability to conduct independent assessments of a contractor's compliance with the requirements of DOE Order 4330.4B, Maintenance Management Program. 239

Competency 1.19

Facility maintenance management (FAC# 2.4) personnel shall demonstrate a familiarity level knowledge of the following maintenance management-related Department of Energy Technical Standards:

- DOE-STD-1050-93, Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities
- DOE-STD-1051-93, Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities
- DOE-STD-1052-93, Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities
- DOE-STD-1053-93, Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities
- DOE-STD-1054-93, Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities
- DOE-STD-1055-93, Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities
- DOE-STD-1064-94, Guideline to Good Practices for Seasonal Facility Preservation at DOE Nuclear Facilities
- DOE-STD-1065-94, Guideline to Good Practices for Post Maintenance Testing at DOE Nuclear Facilities
- DOE-STD-1067-94, Guideline to Good Practices for Maintenance Facilities, Equipment, and Tools at DOE Nuclear Facilities
- DOE-STD-1069-94, Guideline to Good Practices for Maintenance Tools and Equipment Control at DOE Nuclear Facilities
- DOE-STD-1071-94, Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities
- DOE-STD-1072-94, Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities 253

Competency 1.20

Facility maintenance management (FAC# 3.2) personnel shall demonstrate a familiarity level knowledge of facility maintenance management-related data management requirements. 273

Competency 1.21

Facility maintenance management (FAC# 3.3) personnel shall demonstrate a working level knowledge of contractor and Department organization and structure as they relate to maintenance management responsibilities and authority. 279

Competency 1.22

Facility maintenance management (FAC# 4.2) personnel shall demonstrate a working level knowledge of lessons learned and problems impacting the Department's maintenance activities across complex. 285

Competency 1.23

Facility maintenance management (FAC# 4.3) and EH Residents (FAC# 2.16) personnel shall demonstrate a working level knowledge of the requirements of a maintenance management program. 293

Competency 1.24

Facility maintenance management (FAC# 4.7) personnel shall demonstrate the ability to trend facility maintenance management-related data. 305

Competency 1.25

Technical manager (FAC# 1.2) shall demonstrate a familiarity level knowledge of formal conduct of maintenance necessary to ensure implementation. 317

Competency 1.26

Facility Representative (FAC# 4.5) personnel shall demonstrate a working level knowledge of Conduct of Maintenance principles and Department of Energy requirements to ensure maintenance is performed in a safe and efficient manner. . . . 341

Appendix A Glossary A-1

Appendix B Training-to-Competency Matrix B-1

Appendix C References C-1

MAINTENANCE MANAGEMENT

Introduction

1. Scope and Background

The scope of this study guide is to describe requirements for understanding Maintenance Management within the Department of Energy (DOE) nuclear facilities. This study guide provides the participants with the required Competencies, Knowledge and Skills, Self-Study Information, and Practice Exercises necessary for the basic understanding of Maintenance Management processes and procedures. This study guide provides the knowledge and references for personnel to more fully understand the operation of Maintenance Management processes and procedures for the safe and reliable operation of a facility.

This study guide has been developed to support personnel in their efforts to become more technically competent and complete the requirements of DOE's Technical Qualification Program. By providing competencies for which conduct and operation of Maintenance Management can be implemented, a uniform process and program can be established for defense nuclear facility technical personnel.

The competencies developed for this study guide identify a familiarity level; a working level; an expert level of knowledge or skill; or they require the individual to demonstrate the ability to perform a task or activity. These levels are defined as follows:

Familiarity level is defined as a basic knowledge of or exposure to the subject or process adequate to discuss the subject or process with individuals of greater knowledge.

Working level is defined as the knowledge required to monitor and assess operations/activities, to apply standards of acceptable performance, and to reference appropriate material and/or expert advice as required to ensure the safety of Departmental activities.

Expert level is defined as a comprehensive, intensive knowledge of the subject or process sufficient to provide advice in the absence of procedural guidance.

Demonstrate the ability is defined as the actual performance of a task or activity in accordance with policy, procedure, guidelines, and/or accepted industry or Department practices.

Upper tier DOE related material is listed as references for the Knowledge and Skill statements. Minimal site specific reference material has been cited. It is the responsibility of the participating individuals to obtain the site specific procedures driven by the referenced material to assist them in understanding the Knowledge and Skills Statements.

2. Purpose

The purpose of this study guide is to assist personnel in preparing to demonstrate their competency in the area of knowledge of Maintenance Management within the Department of Energy (DOE) complex. This study guide provides the fundamentals for consistent techniques and processes, and allows the participants to focus on performance and effectiveness rather than simple compliance with requirements.

This study guide also provides a matrix of related Maintenance Management training courses available to the participants. The listed courses, in conjunction with the Self-Study Information can be used to satisfy and enhance the competency requirements.

3. How to Use This Guide

- a. Read this guide for those competencies you wish to satisfy through self-study. Review the associated Knowledge and Skills, Self-Study Information, and the items identified in the Reference section. Review the Self-Study Information in this guide, or in the referenced training material. For assistance or additional information, contact your supervisor or subject matter expert at your facility or site, or refer to identified resources in the Training-to-Competencies Matrix located in Appendix B.
- b. Work through the Practice Exercises provided in the document, filling your responses in the space provided. When complete, check your answers against the answers provided in the back of the competency.
- c. Refer to the Glossary (Appendix A), as needed, which contains definitions and terminology.

4. Functional Area Competencies-to-Study Guide Competencies Matrix

- a. Use the matrix on the following pages to determine which competencies in this document you should study. Identify the functional area you are assigned to in the left hand column. Go across that row until you reach a box with a number in it, that number represents the Functional Area Competency number (FAC## x.x). From that box go up the column until you reach the top of the column, the number at the top of the column represents the Topical Area Competency number. Repeat this process for each competency in your row. Locate and study those Topical Competencies in this Self Study Guide.

Example: Locate the Facility Representative functional area. Notice on page x the matrix lists one competency, in the last column is the number 4.5. Proceeding to the Topical Area Study Guide Competencies at the top, Facility Representative personnel should study Competency 1.26 in this document.

If there are no numbers in the row that contains your functional area then this document does not apply to your functional area and you are not required to complete any material in this document.

Example: Locate the Radiation Protection functional area. Notice that there are no numbers in the row to the right of the Radiation Protection functional area, this means there are no competencies in this document that the Technical Manager should study.

MATRIX FUNCTIONAL AREA COMPETENCIES-TO-TOPICAL AREA STUDY GUIDE COMPETENCIES																		
F U N C T I O N A L A R E A	TOPICAL AREA STUDY GUIDE COMPETENCIES																	C O N T I N U E D O N N E X T P A G E
	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.17	
	General Technical Bases																	
	Facility Representative																	
	Technical Manager																	
	Technical Training																	
	Radiation Protection																	
	Environmental Restoration																	
	Waste Management																	
	Environmental Compliance																	
	Fire Protection																	
	Emergency Management																	
	Occupational Safety																	
	Industrial Hygiene																	
	Nuclear Safety																	

MATRIX FUNCTIONAL AREA COMPETENCIES-TO-TOPICAL AREA STUDY GUIDE COMPETENCIES										
F U N C T I O N A L A R E A	TOPICAL AREA STUDY GUIDE COMPETENCIES									
		1.18	1.19	1.20	1.21	1.22	1.23	1.24	1.25	1.26
	General Technical Bases									
	Facility Representative									4.5
	Technical Manager								1.2	
	Technical Training									
	Radiation Protection									
	Environmental Restoration									
	Waste Management									
	Environmental Compliance									
	Fire Protection									
	Emergency Management									
	Occupational Safety									
	Industrial Hygiene									
	Nuclear Safety									

MATRIX FUNCTIONAL AREA COMPETENCIES-TO-TOPICAL AREA STUDY GUIDE COMPETENCIES																		
FUNCTIONAL AREA	TOPICAL AREA STUDY GUIDE COMPETENCIES																	CONTINUED ON NEXT PAGE
	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.17	
	Nuclear Weapons Safety																	
	Civil/ Structural Engineer																	
	Project Management																	
	Safeguards and Security																	
	Electrical Systems		1.16													4.11		
	Instrumentation & Controls		1.25													4.12		
	Facility Maintenance	1.23		1.24	1.25	1.26	1.27	1.28	1.29	1.30	1.31	1.32	1.33	1.34	1.35	1.36	2.1	
	Construction Management																	
	Mechanical Systems		1.27													4.11		
	EH Resident			2.16														
	Chemical Processing																	
	Nuclear Explosives																	

MATRIX FUNCTIONAL AREA COMPETENCIES-TO-TOPICAL AREA STUDY GUIDE COMPETENCIES										
F U N C T I O N A L A R E A	TOPICAL AREA STUDY GUIDE COMPETENCIES									
		1.18	1.19	1.20	1.21	1.22	1.23	1.24	1.25	1.26
	Nuclear Weapons Safety									
	Civil/ Structural Engineer									
	Project Management									
	Safeguards and Security									
	Electrical Systems									
	Instrumentation & Controls									
	Facility Maintenance	4.4	2.4	3.2	3.3	4.2	4.3			4.7
	Construction Management									
A R E A	Mechanical Systems									
	EH Resident						2.16			
	Chemical Processing									
A R E A	Nuclear Explosives									

5. DOE Orders in Transition

DOE Orders are in a stage of transition. However, Order cancellation does not necessarily mean that the Order is no longer in effect. For example, DOE Order 430.1, Life Cycle Asset Management, which deletes or consolidates 13 maintenance-related Orders, states:

"This Order shall be implemented on a site-by-site basis through the establishment, by contract or financial assistance agreements, of site-specific performance criteria and a performance measurement system. The existing Orders listed below and already implemented in current contracts remain in effect until such incorporation takes place. Additionally for specific facilities under the purview of the Defense Nuclear Facilities Safety Board, DOE 4330.4B, Maintenance Management Program, and DOE 6430.1A, General Design Criteria, remain in effect until 10 CFR 830.340, Maintenance Management, and DOE O 420, Facility Safety, for defense nuclear facilities are issued as finals by the Assistant Secretary for Environment, Safety, and Health. For sites not managed by a contractor, implementation shall occur when the responsible DOE organization has completed the development of appropriate performance measures."

DOE 1332.1A Uniform Reporting System	DOE 4540.1C Utility Acquisition and Management
DOE 4010.1A Value Engineering	DOE 4700.1 Project Management
DOE 4300.1C Real Property Management	DOE 4700.3 General Plant Projects
DOE 4320.1B Site Development Planning	DOE 4700.4 Project Manager Certification
DOE 4320.2A Capital Asset Management	DOE 5700.2D Cost Estimating, Analysis, and Standardization
DOE 4330.4B Maintenance Management Program	DOE 6430.1A General Design Criteria
DOE 4330.5 Surplus Facility Transfer	

Although DOE Order 4330.4B has been canceled and replaced Maintenance Managers are reminded that the information contained in the order presents valuable information that is till beneficial towards developing and maintaining a viable and cost effective Maintenance Program.

Rather than publish a matrix of new and old Orders within this study guide, participants should refer to the document "*Crosswalk of Old Directives Numbers to New Directives Numbering System*." This is an excellent resource. It is linked to the DOE homepage "Clearinghouse for Training, Education, and Development" or may be reached directly at the following gopher site:

`gopher://VM1.HQADMIN.DOE.GOV;70/00/doemenu1/directiv/251cross.asc`

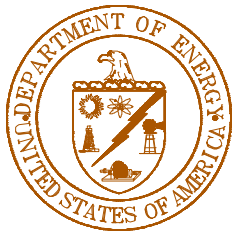
Many of the referenced materials are available by accessing World Wide Web sites supported by DOE and other organizations. The constantly evolving nature of the Internet makes it impossible to guarantee the continuous existence of any referenced site, but some of the more helpful sites are included here:

- American National Standards Institute - <http://www.ansi.org>
- Department of Energy (DOE) Home Page - <http://www.doe.gov>
- ES&H Information Center Navigation Map¹ - <http://tis.eh.doe.gov/map.html>
- DOE Clearinghouse for Training, Education and Development Home Page - <http://cted.inel.gov/cted>
- DOE Lessons Learned Listservice - <http://www.tis.eh.doe.gov/others/ll/listserv.html>
- DOE Course Index - <http://cted.inel.gov/cted/crsindex.html>
- DOE Office of Training HRD, EH Training Material Page - http://cted.inel.gov/cted/eh_mat.html
- DOE OpenNet Database - <http://apollo.osti.gov/html/osti/opennet1.html>
- FedWorld Home Page - <http://www.fedworld.gov>
- U.S. House of Representatives Code of Federal Regulations - <http://www.house.gov>

6. Activities Following Completion of this Guide

- a. When you are ready to be evaluated on the competency(ies) applicable to your functional area, notify your supervisor, who will determine how you will be evaluated. This could include a written exam, oral checkout, or a walkdown. Note that this evaluation may be delegated by your supervisor to another DOE organization or individual (subject matter expert).
- b. Upon successfully demonstrating your competence to the evaluator, your Technical Qualification Record will be updated to document the completed competencies. The evaluator will sign off the designated competency(ies) identified on this matrix.

¹Editor's note - This is an excellent place to start referencing documents.



U.S. Department of Energy
Technical Qualifications

Maintenance Management Topical Area

Self-Study Guide

Competencies

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Competency 1.1

Facility maintenance management personnel (FAC# 1.23) shall demonstrate a working level knowledge of the guidelines for maintaining maintenance facilities, equipment, and tools.

1. Supporting Knowledge and/or Skills
 - a. Discuss the importance of maintaining proper maintenance facilities.
 - b. Describe the criteria used when designing the layout of a shop or satellite work area.
 - c. Discuss when temporary facilities are used, the factors to consider when approving, purchasing, designing and locating temporary facilities.
 - d. Discuss the reasons for segregating tools.
 - e. Discuss the use of contaminated tools versus clean tools.
 - f. Discuss the concerns affecting the selection and state of readiness of maintenance facilities.
 - g. Describe the objective of maintenance facilities.
 - h. Describe the types and levels of environmental controls and services included in shops and satellite work areas.
 - i. Discuss the elements to consider when planning for the identification and use of maintenance laydown and staging areas.
 - j. Discuss the issues addressed when determining storage facility needs.
 - k. Discuss the requirements for storing, issuing, and maintenance of tools and equipment.
 - l. Describe the requirements for office equipment to support the maintenance organization.
 - m. Discuss the criteria of a program for the development of new or special tools and equipment.

2. Self-Study Information

Competency 1.1 addresses skill and knowledge concerning supporting the maintenance facilities, equipment, and tools. Competency 1.1 is at the working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Guideline To Good Practices For Maintenance Facilities, Equipment and Tools At DOE Nuclear Facilities, DOE-STD-1067-94

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- For Supporting Knowledge and Skills **1.1-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.2.1, page I-14 - I-15; Section 4.2, pages II-14 - II-15.
 - Guideline To Good Practices For Maintenance Facilities, Equipment and Tools At DOE Nuclear Facilities (DOE-STD-1067-94), Section 3.1, pages 6 - 7.
- For Supporting Knowledge and Skills **1.1-1.b** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.5.1, page I-29 - I-30 and Section 4.3.1.a, pages II-15 - II-16.
 - Guideline To Good Practices For Maintenance Facilities, Equipment and Tools At DOE Nuclear Facilities (DOE-STD-1067-94), Section 3.4.1.a, pages 9 - 10.
- For Supporting Knowledge and Skills **1.1-1.c** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 4.3.1.d, page II-17.
 - Guideline To Good Practices For Maintenance Facilities, Equipment and Tools At DOE Nuclear Facilities (DOE-STD-1067-94), Section 3.4.1.c, page 11.
- For Supporting Knowledge and Skills **1.1-1.d** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.5.5, page I-34 - I-35; Section 4.3.2, page II-18; and Section 13.3.1, page II-71.

- e. For Supporting Knowledge and Skills **1.1-1.e** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 4.3.1.e, page II-18 and Section 13.3.1, page II-71.
 - Guideline To Good Practices For Maintenance Facilities, Equipment and Tools At DOE Nuclear Facilities (DOE-STD-1067-94), Section 3.4.1.d, page 12.
- f. For Supporting Knowledge and Skills **1.1-1.f** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.2.2, page I-15 and Section 4.3.1.a, pages II-15 - II-16.
 - Guideline To Good Practices For Maintenance Facilities, Equipment and Tools At DOE Nuclear Facilities (DOE-STD-1067-94), Section 3.4.1.a, pages 9 - 10.
- g. For Supporting Knowledge and Skills **1.1-1.g** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 4.1, page II-14.
 - Guideline To Good Practices For Maintenance Facilities, Equipment and Tools At DOE Nuclear Facilities (DOE-STD-1067-94), Section 1.1, page 1.
- h. For Supporting Knowledge and Skills **1.1-1.h** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 4.3.1.a, pages II-15 - II-16.
 - Guideline To Good Practices For Maintenance Facilities, Equipment and Tools At DOE Nuclear Facilities (DOE-STD-1067-94), Section 3.4.1.a, pages 9 - 10.
- i. For Supporting Knowledge and Skills **1.1-1.i** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 4.3.1.b, pages II-16 - II-17.
 - Guideline To Good Practices For Maintenance Facilities, Equipment and Tools At DOE Nuclear Facilities (DOE-STD-1067-94), Section 3.4.1.b, pages 10 - 11.
- j. For Supporting Knowledge and Skills **1.1-1.j** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 4.3.1.c, page II-17.
 - Guideline To Good Practices For Maintenance Facilities, Equipment and Tools At DOE Nuclear Facilities (DOE-STD-1067-94), Section 3.4.2.a, page 12.
- k. For Supporting Knowledge and Skills **1.1-1.k** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.5.1, page I-29 - I-30; Section 4.3.2, page II-18; and Section 13.3, page II-71.
 - Guideline To Good Practices For Maintenance Facilities, Equipment and Tools At DOE Nuclear Facilities (DOE-STD-1067-94), Section 3.4.2.a, page 12.

- l. For Supporting Knowledge and Skills **1.1-1.l** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.5.1, page I-29 - I-30 and Section 4.3.3, page II-18.
 - Guideline To Good Practices For Maintenance Facilities, Equipment and Tools At DOE Nuclear Facilities (DOE-STD-1067-94), Section 3.4.3, page 14.
- m. For Supporting Knowledge and Skills **1.1-1.m** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 4.2, page II-15 and Section 13.3.3, page II-72.
 - Guideline To Good Practices For Maintenance Facilities, Equipment and Tools At DOE Nuclear Facilities (DOE-STD-1067-94), Section 3.4.2.b, page 13.

4. Practice Exercise

- a. What is the objective of maintaining a proper maintenance facilities? (K&S 1.1-1.a)
- b. Describe the criteria used when designing the layout of a shop or satellite work area. (K&S 1.1-1.b)
- c. What services must be considered when using temporary facilities? (K&S 1.1-1.c)
 -
 -
 -
 -
 -
 -

- d. Discuss the reason for segregating tools. (K&S 1.1-1.d)

- e. What environmental controls should be provided for tools and equipment? (K&S 1.1-1.d)
 -
 -
 -
 -

- f. Why are some tools included in the preventive maintenance program? (K&S 1.1-1.d)

- g. Discuss the use of contaminated tools versus clean tools. (K&S 1.1-1.e)

- h. Discuss the concerns affecting the selection and state of readiness of maintenance facilities. (K&S 1.1-1.f)

- i. What is the objective of maintenance facilities? (K&S 1.1-1.g)

- j. What environmental controls and service should be considered when designing the layout of a shop or satellite work area. (K&S 1.1-1.h)

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-

- k. Discuss the elements to consider when planning for the identification and use of maintenance laydown and staging areas. (K&S 1.1-1.i)

- l. Discuss the issues addressed when determining storage facility needs. (K&S 1.1-1.j)
 -
 -
 -
- m. Discuss the requirements for storing, issuing, and maintenance of tools and equipment. (K&S 1.12-1.b)

5. Practice Exercise Answers

- a. What is the objective of maintaining a proper maintenance facilities? (K&S 1.1-1.a)

To ensure a safe and productive work place where high quality work can be performed.

- b. Describe the criteria used when designing the layout of a shop or satellite work area. (K&S 1.1-1.b)

The layout of shops and satellite work areas should be designed with a high priority on industrial safety and efficiency.

Location and type of work performed should be considered in determining the types and levels of environmental controls and services to be included in each maintenance shop and satellite work area.

- c. What services must be considered when using temporary facilities? (K&S 1.1-1.c)

- Electrical power
- Compressed air
- Water
- Environmental controls
- Lighting
- ALARA

- d. Discuss the reason for segregating tools. (K&S 1.1-1.d)

Tools should also be segregated so that only safe, usable tools are available for use.

- e. What environmental controls should be provided for tools and equipment? (K&S 1.1-1.d)

- temperature
- humidity
- dust control
- radioactive contamination

- f. Why are some tools included in the preventive maintenance program? (K&S 1.1-1.d)

Proper preventive maintenance can result in improved personnel safety and extend the life of tools and equipment. Inclusion also enhances the availability and reliability of equipment and tools.

- g. Discuss the use of contaminated tools versus clean tools. (K&S 1.1-1.e)

Decontamination facilities should be used to reduce the volume of solid radioactive waste and reduce the contamination on reusable tools and equipment.

A policy should be established for the storage, issue, decontamination and reuse of contaminated tools and equipment.

- h. Discuss the concerns affecting the selection and state of readiness of maintenance facilities. (K&S 1.1-1.f)

Environmental conditions often have a significant impact on personnel performance. Supervisors need to be responsive to maintaining work place environmental controls conducive to increased maintenance quality and work efficiency.

- i. What is the objective of maintenance facilities? (K&S 1.1-1.g)

Maintenance facilities, equipment, and tools should efficiently support facility maintenance and maintenance training.

- j. What environmental controls and service should be considered when designing the layout of a shop or satellite work area. (K&S 1.1-1.h)

- Fume removal
- temperature, humidity, and dust control
- Equipment space consideration
- Lighting
- Water
- Noise control
- Service and instrument air
- Electrical power supplies
- Radiological controls

- k. Discuss the elements to consider when planning for the identification and use of maintenance laydown and staging areas. (K&S 1.1-1.i)

A plan should be developed and kept current for identification and use of maintenance laydown and staging areas. The plan should define:

- outage support
- area use
- responsibility for area upkeep and control
- authorization for access, including provisions for security and fire protection
- radiological control
- labeling of facilities to designate responsibility and entry authorization
- contingency plans for changes that could render a facility unusable for its intended purpose

- l. Discuss the issues addressed when determining storage facility needs. (K&S 1.1-1.j)

- environmental controls, considering such items as:

- isolation/segregation of chemicals
 - flammability of lubricants and paints
 - qualification of parts/components
 - damage to elastometers and polypropylene parts because of exposure to light
 - control of radioactive materials
 - storage activity controls considering items such as:
 - material receipt
 - inspection
 - handling
 - storage
 - retrieval
 - issuance (see DOE 4330.4B paragraph 11)
 - tool and equipment control (see DOE 4330.4B paragraph 13)
 - inventory level of spare parts, supplies, and equipment (see DOE 4330.4B paragraph 10 and 11)
- m. Discuss the requirements for storing, issuing, and maintenance of tools and equipment. (K&S 1.12-1.b)

Responsibility should be assigned for the proper storage and issuance of both stationary and portable tools and equipment.

Permanent issuance of tools to individuals or groups of craft personnel who use the tools on a day-to-day basis and who are responsible for maintaining the contributes to worker efficiency.

Other tools and equipment should be available on an as-needed basis. These tools should be stored in a centrally located facility readily accessible to the shops and normal work areas. The tools should be readily accessible to craft personnel.

The tools should be controlled with sign-out sheets and tool crib attendants. This is to provide accountability and availability of the tools.

- n. Describe the requirements for office equipment to support the maintenance organization. (K&S 1.1-1.l)

Office equipment should support the maintenance organization in efficiently completing its work in a high quality manner.

Adequate communication, calculation, reproduction, and other office equipment should be accessible and maintained in a reliable working condition.

Computer data bases should be easily accessed by computer terminals.

During outages or other high activity periods, additional office equipment should be provided as needed.

- o. Discuss the criteria of a program for the development of new or special tools and equipment. (K&S 1.1-1.m)

The process of providing and developing tools and equipment should include considerations of cost, control, and storage. Maintenance supervisors should review proposed designs for special tool and equipment to determine cost justification, effectiveness, safety considerations, and the need for reviews by other organizations.

The development of new or special tools should not be so strict that employee innovation is discouraged.

Special tools, test rigs, special equipment, lifting and rigging equipment, and mockups should be suitable for their intended use and properly identified.

Instructions should be provided for the use of special tools and equipment for high hazard or high stress tasks.

Special tools and equipment may require special storage and control and should be handled in accordance with identified requirements.

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Competency 1.2

Electrical systems (FAC# 1.16), Instrumentation and control (FAC# 1.25), and Mechanical maintenance (FAC# 1.27) personnel shall demonstrate a familiarity level knowledge of maintenance management practices related to their specialty areas.

1. Supporting Knowledge and/or Skills

- a. Define each of the following maintenance related terms and explain their relationship to each other.
 - (1) Corrective
 - (2) Planned
 - (3) Preventive
 - (4) Reliability Centered
 - (5) Predictive
- b. Describe the elements of an effective work control program and the documentation used to control maintenance.
- c. Discuss the importance of maintaining a proper balance of preventive and corrective maintenance.
- d. Define the term "life limiting component" and discuss its impact on facility operation.
- e. Identify typical maintenance performance indicators, and discuss their importance.
- f. Discuss the relationship between maintenance and Conduct of Operations, Qualify Assurance, and Configuration Management.
- g. Discuss the requirements for the receipt and inspection of parts, materials, and equipment.
- h. Describe the difference between temporary and permanent repairs/work and the requirements and controls in place to prevent inadvertent modifications.

Competency 1.3

Facility maintenance management (FAC# 1.24) and EH Residents (FAC# 2.16) personnel shall demonstrate a working level knowledge of the application of the different types of maintenance.

1. Supporting Knowledge and/or Skills
 - a. Discuss and compare the following:
 - Corrective maintenance
 - Preventive maintenance
 - Predictive maintenance
 - b. Describe the purpose, use, and content of a master equipment list.
 - c. Discuss the role of the types of maintenance in an effective and efficient maintenance program.
 - d. Discuss the relationship between predictive maintenance and technical safety requirements.
 - e. Discuss the importance of maintaining a proper balance of preventive, predictive, and corrective maintenance.
 - f. Discuss the elements needed to successfully implement a maintenance program that balances the three types of maintenance.
 - g. Describe the relationship in scheduling between preventive and predictive maintenance.
 - h. Discuss the relationship between the results of predictive maintenance and preventive maintenance.
 - i. Discuss the considerations used when determining maintenance actions and their frequencies.
 - j. Define the term "life limiting component" and its impact on facility operation.
 - k. Explain the intent of the DOE Order 4330.4B, Maintenance Management Program.
 - l. Discuss the Department of Energy's policy and objectives for maintenance management.

2. Self-Study Information

Competency 1.2 and 1.3 addresses maintenance management practices and different types of maintenance. Competency 1.2 at a familiarity level of knowledge and Competency 1.3 at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Conduct of Operations Requirements For DOE Facilities, DOE Order 5480.19
- Quality Assurance, DOE Order 5700.6C
- Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities, DOE-STD-1051-93
- Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities, DOE-STD-1052-93
- Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities, DOE-STD-1053-93
- Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities, DOE-STD-1071-94
- Guide for Operational Configuration Management Program, DOE-STD-1073-93-Pts. 1 and 2

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.2-1.a** and **1.3-1.a** refer to:
 - (1) Maintenance Management Program (DOE Order 4330.4B), Section 3.6.3, pages I-38 - I-39 and Section 5.3.2.a, pages II-21 - II-22.
 - (2) Maintenance Management Program (DOE Order 4330.4B), Section 5.2, page II-20.
 - (3) Maintenance Management Program (DOE Order 4330.4B), Section 3.6.1, pages I-35 - I-37 and Section 5.3.2.b, pages II-22 - II-23.
Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities (DOE-STD-1052-93), Section 3.4.3, pages 10 - 13.
 - (4) Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities (DOE-STD-1052-93), Section 2.1.5, pages 5 and Appendix D.
 - (5) Maintenance Management Program (DOE Order 4330.4B), Section 3.6.2, pages I-37 - I-38 and Section 5.3.2.c, pages II-23 - II-24.
Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities (DOE-STD-1052-93), Section 3.4.4, pages 13 - 20.
- b. For Supporting Knowledge and Skills **1.2-1.b** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.4.1, page I-17 - I-19 and Section 8.2, pages II-44 - II-46.
 - Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities (DOE-STD-1053-93), Section 3.1.3, pages 6 - 7.
- c. For Supporting Knowledge and Skills **1.2-1.c**, **1.3-1.e**, and **1.3-1.f** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 5.2, page II-19.
- d. For Supporting Knowledge and Skills **1.2-1.d** and **1.3-1.j** refer to:
 - Guide for Operational Configuration Management Program (DOE-STD-1073-93-Pt. 1, Glossary, page xii and Pt. 2, Section 4.2.2, pages II-89 - II-91.
- e. For Supporting Knowledge and Skills **1.2-1.e** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.7.3, page I-42 - I-43 and Section 2.3.4, pages II-7 - II-8.
 - Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Sections 4.3.2.b and .c, pages 22 - 24.

- f. For Supporting Knowledge and Skills **1.2-1.f** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 1, page I-1; Section 1, page II-1; Section 8.2, page II-47; Section 16.2, page II-84 - II-85; and Section 18.3.1, page II-95.
 - Conduct of Operations (DOE Order 5480.19), General Introduction, Attachment I, page I-12.
 - Quality Assurance (DOE Order 5700.6C), Section 7, page 4 and Section 9.b, pages 5 - 7.
 - Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Section 4.3.4, pages 26 - 28.
 - Guide for Operational Configuration Management Program, DOE-STD-1073-93-Pts. 1, Appendix I-A page I-A-2 - I-A-3.
- g. For Supporting Knowledge and Skills **1.2-1.g** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.5.2 and Section 3.5.3, page I-31 - I-32 and Section 11.3.1, pages II-60 - II-61.
 - Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities (DOE-STD-1071-94), Section 3.4.1, pages 5 - 7.
- h. For Supporting Knowledge and Skills **1.2-1.h** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.6.4, page I-39; Section 8.3.5, page II-50; and Section 18.3, pages II-95 - II-96.
 - Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Sections 4.3.4, pages 26 - 28.
 - Conduct of Operations Requirements For DOE Facilities, (DOE Order 5480.19), Chapter VIII, item 9, page I-51.
- i. For Supporting Knowledge and Skills **1.3-1.b** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 5.3.1, page II-21.
 - Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities (DOE-STD-1052-93), Sections 2.9 and 3.4.1, pages 4 and 10.
- j. For Supporting Knowledge and Skills **1.3-1.c** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 5.2, pages II-19 - II-21.
 - Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities (DOE-STD-1052-93), Sections 3.4.3 and 3.4.4.1, pages 10 and 13.

- k. For Supporting Knowledge and Skills **1.3-1.d** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Sections 3.4 and 3.4.1, page I-17 - I-19; Sections 5.1 and 5.2, pages II-18 - II-20; and Section 8.3.2, page II-47.
- l. For Supporting Knowledge and Skills **1.3-1.g** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.6.1, pages I-35 - I-37 and Section 3.6.2, pages I-37 - I-38; Section 5.3.4, page II-25; and Section 7.3.2, pages II-35 - II-38.
 - Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities (DOE-STD-1052-93), Sections 3.4.3.4 and 3.4.4.6, pages 11 and 18.
- m. For Supporting Knowledge and Skills **1.3-1.h** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 5.3.2.c, page II-23.
 - Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities (DOE-STD-1052-93), Section 3.4.3.2, page 10; Section 3.4.3.6, page 12; and Section 3.4.4.7, pages 19 - 20.
- n. For Supporting Knowledge and Skills **1.3-1.i** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 5.3.3, pages II-24 - II-25.
 - Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities (DOE-STD-1052-93), Appendix 'D', Section 8, pages D-33 - D-43.
- o. For Supporting Knowledge and Skills **1.3-1.k** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 1, page 1 and Section 2, page I-3.
- p. For Supporting Knowledge and Skills **1.3-1.l** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Sections 7 and 8, pages 3 - 4.

The Maintenance Management Program described in DOE Order 4330.4B incorporates the concepts included in DOE Order 5480.19 associated with matters related to the maintenance program. For example, the guidance provided for maintenance procedures is consistent with the procedure direction provided in the Conduct of Operations Order. Additionally, the "cultural" aspects of ConOps is easily integrated into the Maintenance Program. These are "best business" practices that should result in the high standard of maintenance performance required to support safe and reliable operations.

The concepts identified in DOE Order 5700.6C were utilized in the development of the Maintenance Management Program described in DOE Order 4330.4B. The Quality Assurance requirements stipulated were established and integrated into the Maintenance Management Program Order to ensure that risks and environmental impacts were minimized and that safety, reliability and performance were maximized through the application of effective management systems commensurate with the risks posed by the facility and its maintenance activities. Specifically, the principles of each Quality Assurance Criteria, in the areas of Management, Performance and Assessment, were evaluated for inclusion into each Maintenance Management Program Element.

4. Practice Exercise

- a. Match the definition in column A with the term in column B. Use the column B answers one time only. Ignore any response in column B not identified in column A. (K&S 1.2-1.a) (K&S 1.3-1.a)

Column A	Column B
___ 1. The repair of failed or malfunctioning equipment, system, or facilities to restore the intended function or design condition. This maintenance does not result in significant extension of expected useful life.	a. Planned
	b. Maintenance
	c. Corrective
___ 2. Periodic, and planned maintenance actions taken to maintain a piece of equipment within design operating conditions and extend its life.	d. Reliability Centered
	e. Preventive
___ 3. Activities performed prior to equipment failure. The activities can be initiated by predictive or periodic maintenance results, by vendor recommendations, or by experience.	f. Predictive
___ 4. Activities involving continuous or periodic monitoring and diagnosis to forecast equipment failure.	

- b. Describe the elements of an effective work control program and the documentation used to control maintenance. (K&S 1.2-1.b)

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- c. Discuss the importance of maintaining a proper balance of preventive and corrective maintenance. (K&S 1.2-1.c) (K&S 1.3-1.e) (K&S 1.3-1.f)

- d. Define the term "life limiting component". (K&S 1.2-1.d) (K&S 1.3-1.j)

- e. What criteria should be used to determine if a component should be classified as a "life limiting component". (K&S 1.2-1.d) (K&S 1.3-1.j)
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- f. List maintenance goals that can be used as a management tool for improving maintenance performance and measuring maintenance effectiveness. (K&S 1.2-1.e)
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Performance Indicators should:

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The following topics should also be continually reviewed:

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- i. For each of the following Maintenance Management Program Elements identify a Conduct of Operations Element that when integrated will lead to an enhancement in the Maintenance Element. Note: In some cases the ConOps elements may apply to more than Maintenance Element. (K&S 1.2-1.f)

Maintenance element	Conduct Of Operations element
Training and Qualification of Maintenance Personnel	
Planning, Scheduling, and Coordination of Maintenance	
Control of Maintenance Activities	
Post-Maintenance Testing	
Facility Condition Inspection	
Maintenance History	
Analysis of Maintenance Problems	
Modification Work	

- j. For each Maintenance Management Program Element below, identify a Quality Assurance Criteria that would be used in the development and/or implementation of the Maintenance Program. Note: In some cases the QA Criterion may apply to more than one Maintenance element. (K&S 1.2-1.f)

Maintenance Element	Criterion # , Name
Maintenance Organization and Administration	Criterion
Training and Qualification of Maintenance Personnel	Criterion
Maintenance Facilities, Equipment and Tools	Criterion
Types of Maintenance	Criterion
Maintenance Procedures	Criterion
Planning, Scheduling, and Coordination of Maintenance	Criterion
Control of Maintenance Activities	Criterion
Post-Maintenance Testing	Criterion
Procurement of Parts, Materials, and Services	Criterion
Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance	Criterion
Control and Calibration of Measuring and Test Equipment	Criterion
Maintenance Tools and Equipment Control	Criterion
Facility Condition Inspection	Criterion
Management Involvement	Criterion
Maintenance History	Criterion
Analysis of Maintenance Problems	Criterion
Modification Work	Criterion

- k. Discuss the relationship between maintenance and Configuration Management. (K&S 1.2-1.f)

- l. What should be done with nonconforming material, discovered during the receipt and inspection of parts, materials, and equipment. (K&S 1.2-1.g)

Non-conforming items should be:

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- m. Discuss the requirements for the receipt and inspection of parts, materials, and equipment important to safe and reliable facility operations. (K&S 1.2-1.g)

Check the items to ensure that items are:

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- n. Describe the difference between temporary and permanent repairs/work and the requirements and controls in place to prevent inadvertent modifications. (K&S 1.2-1.h)

- o. Describe the purpose, use, and content of a master equipment list. (K&S 1.3-1.b)

The following should be considered for selecting equipment to be included in the program:

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- p. What type of maintenance is performed following root cause analysis? (K&S 1.3-1.c)
- 1) Analytical maintenance
 - 2) Corrective maintenance
 - 3) Predictive maintenance
 - 4) Preventive maintenance
- q. Discuss the relationship between predictive maintenance and technical safety requirements. (K&S 1.3-1.d)

- r. Describe the relationship in scheduling between preventive and predictive maintenance.
(K&S 1.3-1.g)

- s. Describe the relationship in scheduling between preventive and predictive maintenance.
(K&S 1.3-1.g)

- t. Discuss the relationship between the results of predictive maintenance and preventive maintenance. (K&S 1.3-1.h)

- u. Discuss the considerations used when determining maintenance actions and their frequencies. (K&S 1.3-1.i)

The actions selected and their frequencies should be determined, based on such considerations as the following:

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- v. State the four (4) categories of Preventive Maintenance tasks. (K&S 1.3-1.i)

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- w. Concerning the determination of tasks intervals for preventive maintenance: (K&S 1.3-1.i)
- 1) What is the first interval requirement based on?

 - 2) What are the subsequent interval requirements based on?
- x. Explain the intent of the DOE Order 4330.4B, Maintenance Management Program. (K&S 1.3-1.k)
- y. Discuss the Department of Energy's policy and objectives for maintenance management. (K&S 1.3-1.l)
- It is the Department's policy that:
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- z. Discuss the Department of Energy's objectives for maintenance management. (K&S 1.3-1.1)

DOE maintenance management objectives are as follows:

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5. Practice Exercise Answers

- a. Match the definition in column A with the term in column B. Use the column B answers one time only. Ignore any response in column B not identified in column A. (K&S 1.2-1.a) (K&S 1.3-1.a)

Column A	Column B
c 1. The repair of failed or malfunctioning equipment, system, or facilities to restore the intended function or design condition. This maintenance does not result in significant extension of expected useful life.	a. Planned
	b. Maintenance
	c. Corrective
e 2. Periodic, and planned maintenance actions taken to maintain a piece of equipment within design operating conditions and extend its life.	d. Reliability Centered
	e. Preventive
a 3. Activities performed prior to equipment failure. The activities can be initiated by predictive or periodic maintenance results, by vendor recommendations, or by experience.	f. Predictive
f 4. Activities involving continuous or periodic monitoring and diagnosis to forecast equipment failure.	

- b. Describe the elements of an effective work control program and the documentation used to control maintenance. (K&S 1.2-1.b)

The work control program is an administrative method by which maintenance activities are identified, initiated, planned, approved, scheduled, coordinated, performed, and reviewed for adequacy and accuracy. The program should address the following areas:

- Administrative procedures should describe the control of work from identification and planning through completion, review and storage of history data. Personnel involved in the conduct and support of maintenance should be trained in the use of these procedures.
- The responsibility for various types of work should be identified.
- A work request form (and/or work package) should be prepared and used to direct and document maintenance activities. This form should provide for documented review at the appropriate level. The work request should be used to control maintenance activities by ensuring correct equipment isolation, personnel safety, and the proper conduct of maintenance and post-maintenance tests.
- Troubleshooting should be controlled to prevent unplanned repairs and unauthorized modifications.

- The requested work should be reviewed to ensure unauthorized modifications are not accomplished by the maintenance request.
 - Goals for high quality workmanship, safe work practices, and improving radiological protection should be emphasized to maintenance personnel. A key factor in achieving these goals is worksite guidance and overview provided by maintenance supervisors. Monitoring to identify rework can be effectively used to identify programmatic or qualification deficiencies.
 - Work accomplished and the results of post maintenance tests, including satisfactory return to service of the equipment, should be documented.
 - Work requests should be reviewed following the completion of maintenance to verify that the activity was satisfactorily completed in accordance with facility procedures and standards and to capture maintenance history data.
 - Temporary repairs should be performed under the facility's temporary modification program to provide engineering review of the adequacy of the temporary repair and a means for identifying required permanent repair.
 - Non-facility contractor personnel and subcontractors conducting maintenance should be controlled and held accountable to the same policies and procedures as facility personnel.
- c. Discuss the importance of maintaining a proper balance of preventive and corrective maintenance. (K&S 1.2-1.c) (K&S 1.3-1.e) (K&S 1.3-1.f)

The purpose of preventive maintenance is to eliminate or minimize the failure of equipment whose failure can limit safe or reliable operation or result in forced outages.

On important systems and equipment, a thorough technical analysis using methods such as reliability-centered maintenance may be needed to establish a balance between preventive and corrective maintenance. On less important systems, the amount of preventive maintenance to be performed may be used using a more basic judgmental engineering analysis or suggestions from equipment manufacturers and good engineering practices.

Costs associated with preventive maintenance should be offset by improved facility reliability and availability and by reduced corrective maintenance. Excessive or unnecessary preventive maintenance can consume resources that could otherwise be used to extend the scope of the preventive maintenance program and may also increase maintenance errors, rework, and personnel radiation exposure.

- d. Define the term "life limiting component". (K&S 1.2-1.d) (K&S 1.3-1.j)
A structure, system, or component (SSC) whose failure could result in termination of facility operations.
- e. What criteria should be used to determine if a component should be classified as a "life limiting component". (K&S 1.2-1.d) (K&S 1.3-1.j)
- replacement cost is large
 - replacement schedule is long
 - failure may have significant impact on facility safety
 - known history of safety concern exists.
 - operating conditions or environment are relatively harsh
- f. List maintenance goals that can be used as a management tool for improving maintenance performance and measuring maintenance effectiveness. (K&S 1.2-1.e)
- minimize the impact on planned outages by planning and completing maintenance activities in a timely manner;
 - minimize the number of forced outages;
 - minimize the lost-time accident rate;
 - minimize facility and equipment downtime;
 - minimize personnel errors;
 - minimize process delays in work controls and work execution;
 - minimize radiological exposure consistent with DOE 5480.11 Radiation Protection for Occupational Workers;
 - control and reduce contaminated areas;
 - reduce repeat maintenance work requests (rework);
 - complete scheduled surveillances and preventive maintenance activities in a timely manner;
 - minimize the maintenance backlog and reduce the completion time of outstanding deficiencies;
 - control overtime; and
 - complete outage and non-outage work on schedule.
- g. When developing lists of maintenance activities to monitor for performance, what type of activities should the emphasis be placed on? (K&S 1.2-1.e)
The emphasis should be on activities that affect safe and reliable plant operations.

- h. Identify typical maintenance performance indicators. (K&S 1.2-1.e)
- Post-Maintenance test results.
 - Periodic surveillance test results.
 - Ratio of preventive maintenance costs to total corrective cost.
 - Maintenance work request backlog.
 - Time to restore component function after failure discovery.
 - Frequency of maintenance rework.
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- Corrective maintenance backlogged over three months.
 - Preventive maintenance items overdue.
 - Maintenance overtime worked.
 - Ratio of preventive maintenance to total maintenance.
 - Maintenance related radiation exposure.
 - Maintenance caused trips.
 - Actual PM manhours versus estimated PM manhours.
 - Equipment caused equivalent unavailability.
 - Ratio of preventive maintenance costs to total maintenance cost.
 - Actual maintenance costs versus budgeted maintenance costs.
 - Actual preventative maintenance (PM) costs versus budgeted costs.
 - Top contributors to unavailability - PM to total maintenance cost.
 - Percent of reworked PMs.
 - Equivalent unavailability due to performing PMs.
 - Aged PM backlog by priority (using current system of prioritizing).
 - Equipment failures versus backlogged PMs.
 - Unavailability versus PM cost.

Performance Indicators should:

- Easy to calculate.
- Data presently available or easily gathered.
- Directly related to PM Program Performance.
- Related to a specific PM problem.
- Accurately calculated promptly at end of the period of concern.
- Diagnose problems and recommend actions to correct.
- Sensitive to change (outside normal variability), and is not sensitive to non-PM program changes.
- Applicable/useful to multiple levels of the organization.

Performance indicator show over a period of time possible problems. The analysis of the PI is required to positively identify the problem.

The following topics should also be continually reviewed:

- significant program elements to determine and recommend opportunities for maintenance program improvement
 - critical work in progress
 - system and procedure applicability
 - real-time and history data
 - root cause resolution
 - activity intervals and acceptance criteria
 - acquire and apply value-added new technology
 - project status
 - non-facility maintenance personnel performance
 - site planning
- i. For each of the following Maintenance Management Program Elements identify a Conduct of Operations Element that when integrated will lead to an enhancement in the Maintenance Element. Note: In some cases the ConOps elements may apply to more than Maintenance Element. (K&S 1.2-1.f)

Maintenance element	Conduct of Operations element
Training and Qualification of Maintenance Personnel	Control of On-shift Training
Planning, Scheduling, and Coordination of Maintenance	Operations Turnover
Control of Maintenance Activities	Shift Routines and Operating Practices
Post-Maintenance Testing	Control of Equipment and System Status
Facility Condition Inspection	Equipment and Piping Labeling
Maintenance History	Logkeeping
Analysis of Maintenance Problems	Investigation of Abnormal Events
Modification Work	Control of Equipment and System Status

- j. For each Maintenance Management Program Element below, identify a Quality Assurance Criteria that would be used in the development and/or implementation of the Maintenance Program. Note: In some cases the QA Criterion may apply to more than one Maintenance element. (K&S 1.2-1.f)

Maintenance element	Criterion # and name
Maintenance Organization and Administration	Criterion 1, Program
Training and Qualification of Maintenance Personnel	Criterion 2, Personnel Training and Qualifications
Maintenance Facilities, Equipment and Tools	Criterion 5, Work Process
Types of Maintenance	Criterion 5, Work Process
Maintenance Procedures	Criterion 5, Work Process
Planning, Scheduling, and Coordination of Maintenance	Criterion 1, Program
Control of Maintenance Activities	Criterion 5, Work Process
Post-Maintenance Testing	Criterion 8, Inspection and Acceptance Testing
Procurement of Parts, Materials, and Services	Criterion 7, Procurement
Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance	Criterion 5, Work Process
Control and Calibration of Measuring and Test Equipment	Criterion 8, Inspection and Acceptance Testing
Maintenance Tools and Equipment Control	Criterion 5, Work Process
Facility Condition Inspection	Criterion 10, Independent Assessment
Management Involvement	Criterion 9, Management Assessment
Maintenance History	Criterion 4, Document and Records
Analysis of Maintenance Problems	Criterion 3, Quality Improvement
Modification Work	Criterion 6, Design

- k. Discuss the relationship between maintenance and Configuration Management. (K&S 1.2-1.f)

DOE 4330.4B addresses the need for and conduct of maintenance through predictive and preventive maintenance. However it does not provide technical guidance on how the establishment and or forecasting of degradation of equipment, structures, systems, or components (SSC). The Configuration Management process addresses Material Condition and Aging Management (MCA). MCA develops analytical methods and testing techniques that can be used to meet the requirements of the maintenance program.

Configuration Management program also interfaces with the maintenance program through the change control and document control elements, which address control of hardware and procedure changes. The main interface is through the work control process of the maintenance program which manages and sequences maintenance activities in the field. Another important interface exists between the preventive and predictive maintenance activities and the performance monitoring function of the assessment element.

Configuration control is maintained by ensuring that systems and equipment are restored to their original condition following maintenance.

- l. What should be done with nonconforming material, discovered during the receipt and inspection of parts, materials, and equipment. (K&S 1.2-1.g)

Nonconforming material must be clearly tagged or labeled to prevent inadvertent issue. A tracking or follow up method should be established to ensure non-conformance problems are promptly resolved. (DOE 4330.4B)

Non-conforming items should be:

- clearly identified
- segregated from normal items to prevent inadvertent use
- documented on a Non-Conformance Report and/or a Defective or Substandard Material Report
- tracked and dispositioned as soon as practical by the applicable authority.(DOE-STD-1071-94)

- m. Discuss the requirements for the receipt and inspection of parts, materials, and equipment important to safe and reliable facility operations. (K&S 1.2-1.g)

Check the items to ensure that items are:

- physically inspected to ensure that the vendor has supplied what was ordered
- accompanied by the necessary formal documentation or the documentation is otherwise on hand
- that items have been received in an acceptable condition.

- n. Describe the difference between temporary and permanent repairs/work and the requirements and controls in place to prevent inadvertent modifications. (K&S 1.2-1.h)

Temporary repairs are temporary modifications to the facility that allow equipment to remain in or be returned to service in a condition that is not the same as the original design specification. Prior to implementation, temporary repairs should receive a safety review in accordance with the facility temporary modification program to ensure the adequacy of the repair and its effect on personnel and equipment safety and reliability. Temporary repairs should be tracked after their completion for consideration of permanent repairs. Permanent corrective action should be taken as soon as practicable.

- o. Describe the purpose, use, and content of a master equipment list. (K&S 1.3-1.b)

The master equipment list is a compilation of equipment, components, and structures including special tools and equipment used in selecting and scheduling preventive maintenance and assisting in the evaluation of the maintenance program. The list should include both safety related and non-safety related systems and components. This list may sometimes be referred to as the master equipment data base. The master list should be adjusted as dictated by experience, cost-effectiveness, and maintenance history records of equipment performance. The following should be considered for selecting equipment to be included in the program:

- equipment affecting personnel safety
- equipment affecting safe and reliable plant operation
- equipment specified in code, regulatory, or technical safety requirements

- p. What type of maintenance is performed following root cause analysis? (K&S 1.3-1.c)

1) Analytical maintenance

2) Corrective maintenance

3) Predictive maintenance

4) Preventive maintenance

- q. Discuss the relationship between predictive maintenance and technical safety requirements. (K&S 1.3-1.d)

Certain predictive maintenance activities may satisfy requirements with Technical Safety Requirements.

- r. Describe the relationship in scheduling between preventive and predictive maintenance. (K&S 1.3-1.g)

Each preventive maintenance action should be scheduled in a manner that allows consideration for performing other related maintenance at the same time. Preventive maintenance should be scheduled at appropriate intervals and where practical scheduled with corrective maintenance, surveillance, and In-service Inspections/In-service Testing (ISI/IST) test activities on the same equipment and with other related maintenance.

- s. Describe the relationship in scheduling between preventive and predictive maintenance. (K&S 1.3-1.g)

Preventive maintenance actions should be scheduled at appropriate intervals and, when possible, combined with corrective maintenance activities on the same equipment and with other related maintenance based on equipment similarity or proximity.

Considerations such as operational experience, vendor recommendations, engineering analysis, cost/benefit analysis, climate, and especially reliability considerations are used as a basis to establish preventive maintenance tasks and intervals.

Predictive maintenance techniques, such as reliability-centered maintenance (RCM) programs, are used to identify the need for preventive maintenance prior to equipment failure. Mechanisms are established to provide feedback to the facility maintenance program in time to preclude equipment failure. The predictive maintenance program provides data to the preventive maintenance program. For all system, component, equipment failures, the root cause is determined, if possible, and the preventive maintenance program modified. Because all equipment conditions and failures modes can not be monitored, predictive maintenance is selectively applied where experience indicates that it is most cost-effective or best enhances safety.

- t. Discuss the relationship between the results of predictive maintenance and preventive maintenance. (K&S 1.3-1.h)

Predictive maintenance should provide data to the preventive maintenance program and provide and retrieve equipment history data. Root causes should be determined, if possible, and action taken and results fed back into the program.

- u. Discuss the considerations used when determining maintenance actions and their frequencies. (K&S 1.3-1.i)

Using the master equipment list (MEL), preventive actions and their frequencies are analyzed to identify periodic actions that should be taken to improve equipment performance. The actions selected and their frequencies should be determined, based on such considerations as the following:

- regulatory and code requirements;
- vendor recommendations;
- experience at this and similar facilities;
- maintenance history;
- engineering judgement;
- cost/benefit engineering;
- available personnel;
- minimizing personnel radiation exposure using ALARA principles;
- function, ease of replacement, and demonstrated reliability of equipment or system;
- optimizing equipment or system availability during unit operating conditions; and
- operating history.

- v. State the four (4) categories of Preventive Maintenance tasks. (K&S 1.3-1.i)

- Time directed task
- Condition-monitoring task
- Condition-directed task
- Failure-finding task

- w. Concerning the determination of tasks intervals for preventive maintenance: (K&S 1.3-1.i)

- 1) What is the first interval requirement based on?

It must be long enough to ensure that some physical deterioration may be detected.

- 2) What are the subsequent interval requirements based on?

It must be short enough to ensure that further degradation is detected before failure occurs.

- x. Explain the intent of the DOE Order 4330.4B, Maintenance Management Program. (K&S 1.3-1.k)

The purpose of DOE Order 4330.4B, Maintenance Management Program, is to provide a general policy and objectives for the establishment of programs for the management and performance of cost effective maintenance and repair of Department of Energy property.

Maintenance management is the administration of a program utilizing concepts such as planning, procedures, schedules, cost control, and evaluation for the effective performance and control of maintenance, with adequate provisions for interfaces with other concerned disciplines such as health, safety, environmental compliance, quality control, and security.

- y. Discuss the Department of Energy's policy and objectives for maintenance management. (K&S 1.3-1.l)

It is the Department's policy that:

- The maintenance management program for all DOE property be consistent with this Order and that all DOE property be maintained in a manner which promotes operational safety, worker health, environmental protection and compliance, property preservation, and cost-effectiveness while meeting the programmatic mission.
- Structures, systems, and components that are important to the safe operation shall be subject to a maintenance program in order to meet or exceed their design requirements throughout their life.
- Periodic inspection of structures, systems, and components, and equipment be performed to determine deterioration or technical obsolescence which threaten performance and/or safety.
- Primary responsibility, authority, and accountability for the direction and management of the maintenance program for all property reside with the line management assigned direct programmatic responsibility.

- z. Discuss the Department of Energy's objectives for maintenance management. (K&S 1.3-1.1)

DOE maintenance management objectives are as follows:

- Develop a cost-effective and efficient maintenance program for all DOE property that is consistent with DOE's mission, safety and health, reliability, quality, and environmental protection objectives.
- Establish a review and analysis capability for evaluation of maintenance program performance and effectiveness.
- Ensure the reliability, safety, and operability of structures, systems, and components.
- Ensure compliance with environmental, safety, and health standards.
- Ensure that the responsibility, authority, and accountability for maintenance are clearly defined and appropriately assigned.
- Ensure that, where maintenance requirements or accepted maintenance standards cannot be met, such instances are appropriately documented and acknowledged by line management.
- Ensure that sufficient resource are budgeted in a timely manner to accomplish the maintenance program.
- Ensure that effective programs are in place to evaluate and measure property condition.
- Ensure that a graded approach is taken by line management in the development and implementation of maintenance programs.
- Ensure that maintenance of DOE property meets the equivalent guidelines, as appropriate, as required for the conduct of maintenance in commercial industry.

Competency 1.4

Facility maintenance management (FAC# 1.25) personnel shall demonstrate a working level knowledge of the documentation used for controlling maintenance.

1. Supporting Knowledge and/or Skills
 - a. Discuss the purpose, use, and content of a work package.
 - b. Discuss the purpose, use, and contents of maintenance procedures including the following considerations:
 - Development, including human factor considerations
 - Verification
 - Validation
 - Approval
 - Actions taken when procedures cannot be followed as written or when unexpected results occur.
 - c. Discuss the considerations for developing maintenance procedures.
 - d. Describe the control, review, and revision of maintenance procedures.
 - e. Discuss the minimum items addressed in effective work control procedures.
2. Self-Study Information

Competency 1.4 addresses documentation used for controlling maintenance. Competency 1.4 is at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities, DOE-STD-1053-93

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.4-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Sections 3.4 and 3.4.1, page I-17 - I-19; and Section 8.2, page II-44 - II-45.
 - Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities (DOE-STD-1053-93), Section 3.4.2, pages 10 - 14.
- b. For Supporting Knowledge and Skills **1.4-1.b** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.4.5, page I-22 - I-24; Section 6.2, page II-26; and Sections 6.3.2, 6.3.3, 6.3.4 and 6.3.5, pages II-28 - II-29.
- c. For Supporting Knowledge and Skills **1.4-1.c** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 6.3.1, page II-26 - II-28.
- d. For Supporting Knowledge and Skills **1.4-1.d** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 6.3.6, page II-29 - II-31.
- e. For Supporting Knowledge and Skills **1.4-1.e** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.4.1, page I-17 - I-19 and Section 8.3.1, page II-46 - II-47.

4. Practice Exercise

- a. What is the purpose of the work control program. (K&S 1.4-1.a)

- b. Discuss how the use of a work package prevents unauthorized modifications. (K&S 1.4-1.a)
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- c. Discuss the purpose, use, and contents of maintenance procedures. (K&S 1.4-1.b)

- d. Discuss the development, including human factor considerations of maintenance procedures. (K&S 1.4-1.b) (K&S 1.4-1.c)

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e. Discuss the verification of maintenance procedures. (K&S 1.4-1.b)

f. Discuss the validation of maintenance procedures. (K&S 1.4-1.b)

g. Discuss the approval of maintenance procedures. (K&S 1.4-1.b)

- h. Discuss the use of maintenance procedures including actions taken when procedures cannot be followed as written or when unexpected results occur.(K&S 1.4-1.b)

i. Describe the control of maintenance procedures. (K&S 1.4-1.d)

j. Describe the review of maintenance procedures. (K&S 1.4-1.d)

- k. Describe the revision of maintenance procedures. (K&S 1.4-1.d)

A procedure revision should be initiated when:

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- l. Discuss the minimum items addressed in effective work control procedures. (K&S 1.4-1.e)

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5. Practice Exercise Answers

- a. What is the purpose of the work control program. (K&S 1.4-1.a)
The work control program is an administrative method by which maintenance activities are identified, initiated, planned, approved, scheduled, coordinated, performed, and reviewed for adequacy and accuracy.
- b. Discuss how the use of a work package prevents unauthorized modifications. (K&S 1.4-1.a)
- A work request form (and/or work package) should be prepared and used to direct and document maintenance activities. This form should provide for documented review at the appropriate level. The work request should be used to control maintenance activities by ensuring correct equipment isolation, personnel safety, and the proper conduct of maintenance and post-maintenance tests.
 - The requested work should be reviewed to ensure unauthorized modifications are not accomplished by the maintenance request.
 - Troubleshooting should be controlled to prevent unplanned repairs and unauthorized modifications.
 - Work requests should be reviewed following the completion of maintenance to verify that the activity was satisfactorily completed in accordance with facility procedures and standards and to capture maintenance history data.
 - Temporary repairs should be performed under the facility's temporary modification program to provide engineering review of the adequacy of the temporary repair and a means for identifying required permanent repair.
- c. Discuss the purpose, use, and contents of maintenance procedures. (K&S 1.4-1.b)
Maintenance procedure and other work-related documents (e.g., drawings and instructions) should be prepared and used to provide appropriate work direction and to ensure that maintenance is performed safely and efficiently. One of the key elements needed to consistently perform maintenance in a safe and efficient manner is the proper use of written procedures. A balanced combination of written guidance, craft skills, and worksite supervision is required to achieve the quality workmanship essential to safe and reliable facility operation.

- d. Discuss the development, including human factor considerations of maintenance procedures. (K&S 1.4-1.b) (K&S 1.4-1.c)

Maintenance procedures must be written for the craft person and should include the following:

- Procedure identification and status (titling or numbering, location, and page and revision identification)
- procedure purpose and scope
- consistent format (for organization, instruction step format, instruction step designation, caution and note format, and page format)
- clearly understood text, using standard grammar and punctuation
 - appropriate level of detail
 - concise instruction steps in logical sequence
 - proper agreement of multiple verb objects
 - specific nomenclature
 - quantitative and compatible values
 - referencing and branching methods
 - coordination of multiple actions
 - warning and caution location
 - effective formatting
 - and clear table, graph, and data sheet layout
- consistent use of illustrations (e.g., preparation, compatibility, views, level of detail, legibility when reproduced)
- clear indication of steps that could initiate an equipment trip or transient or the initiation or interruption of any process action
- clear indication of hold points, independent verification requirements, or data to be recorded
- systematic facility and system prerequisites, precautions, and limitations, required special tools and materials, and required personnel
- clear indication of acceptance criteria, follow-on steps, and restoration instructions
- steps that inform operations personnel of expected alarms or equipment operations
- guidance to craft personnel to notify the operations organization of maintenance that cannot be completed as originally planned or will be delayed and extended past the anticipated schedule and/or across shift changes
- procedure development and preparation using personal computer desktop publishing and computer-aided writing programs.

- e. Discuss the verification of maintenance procedures. (K&S 1.4-1.b)

Verification is a review to ensure the proper format and technical accuracy of a new or revised procedure. This review should ensure that the format incorporates human-factors principles and other appropriate administrative policies. The technical accuracy review should also include a review of the procedure against the design requirements for that system or component.

Verification should be conducted by one or more reviewers who were not involved in writing the procedure. Other disciplines such as health physics and operations should be considered for the review process.

- f. Discuss the validation of maintenance procedures. (K&S 1.4-1.b)

Validation is a review of a procedure to ensure its usability and correctness. This validates that the procedure provides sufficient and understandable guidance and direction to the craft person and that the procedure is compatible with the equipment or system being maintained.

Validation may be conducted in a shop, in a training environment, on a mockup or simulator, or in some cases by the craft person and supervisor during the first use of the procedure.

- g. Discuss the approval of maintenance procedures. (K&S 1.4-1.b)

Approval should be consistent with facility technical specifications or their equivalent and administrative procedures. As a minimum, the maintenance manager or designee should approve maintenance procedures.

- h. Discuss the use of maintenance procedures including actions taken when procedures cannot be followed as written or when unexpected results occur.(K&S 1.4-1.b)

Procedure compliance requirements should be clearly stated in the procedure or provided as general administrative guidance and should be thoroughly understood by facility personnel. Compliance requirements may vary considerably, depending on the proficiency of the craft person and the potential impact of the maintenance being performed on safety, reliability, and continuity of operation. Managers and supervisors should require and enforce procedural compliance requirements established by facility administrative controls. Normally, two levels of compliance are defined:

- Step-by-step compliance without deviation (such compliance is normally expected for maintenance on safety equipment, for equipment important to facility reliability, and for any activity that could result in a transient or facility shutdown).
- General intent compliance(the experience judgement of the craft person or supervisor is exercised to carry out the maintenance).

Other compliance categories and definitions may be used, such as identifying a group of steps that may be performed out of sequence. Procedures or portions of procedures required to be in hand and reviewed step by step when performing maintenance should be clearly identified.

Procedure users should understand the need to use procedures with forethought and good judgement, even when step-by-step compliance is not required. Procedure users should question and seek resolution for any situation that, in their judgement, warrants supervisory assistance. Supervisors or managers should resolve such inquiries in a timely manner.

Maintenance and, if appropriate, operations supervisors should be notified immediately when a procedure cannot be followed as written or unexpected results occur. In these instances, work should be stopped with the equipment or system restored to a safe condition. Procedures may need to be changed or revised in accordance with approved administrative procedures.

i. Describe the control of maintenance procedures. (K&S 1.4-1.d)

Responsibilities for procedure program administration should be clearly defined. Procedures should be controlled in accordance with facility administrative requirements.

Controls are needed to allow for procedure changes (temporary alternations of procedures so that work can be safely continued) and revision (permanent alterations of procedures that incorporate outstanding temporary changes and other needed updates). Changes and revisions are necessary to correct errors and to ensure that procedures reflect current maintenance practices and requirements. Procedure changes do not normally involve retyping or reissuing an entire procedure. As a minimum, these changes should be reviewed and approved by technically competent supervisors, even though these changes may or may not become permanent later. Changes that are needed to remain in effect beyond their original intent should receive the same review and approval as a revision as soon as feasible (normally, within 2 weeks). Procedure change information should be inserted neatly in the body of the procedure to avoid missing the changes when the procedure is used.

Copies of each procedure should be controlled so that only the current approved revision with any applicable changes is available for use by the craft person.

j. Describe the review of maintenance procedures. (K&S 1.4-1.d)

All procedures should be periodically reviewed (e.g., every 2 years or prior to use for infrequently used procedures) for changes affecting content (such as reference material revisions, permanent incorporation of changes, incorporation of industry and in-house experience) and for philosophy and format enhancements and human factors considerations. Checklists for the review should be utilized to ensure the scope and depth of the review is consistent and adequate. Procedure revisions should receive the same review and approval as new procedures, with the extent of these reviews varying dependent upon the extent of the revision. A method should exist to ensure that the technical specification and other commitments are not inadvertently changed or deleted in the process of reviewing a procedure.

k. Describe the revision of maintenance procedures. (K&S 1.4-1.d)

A procedure revision should be initiated when:

- a change has been outstanding for an extended period (normally, longer than 6 months)
- a procedure has been affected by several changes
- a single change becomes so extensive that the procedure is difficult to follow.

When the procedure is revised, all effective procedure changes should normally be incorporated into the revision.

A system should also be in place to ensure that facility, system, and component changes or modifications adequately identify procedures impacted by the change and provide for their revision as required.

l. Discuss the minimum items addressed in effective work control procedures. (K&S 1.4-1.e)

The work control procedures should describe the work request form, including applicable attachments, and should, as a minimum, address the following:

- personnel responsibilities for identifying deficiencies and initiating work requests that adequately describe the symptoms or problems
- supervisory responsibility for controlling the conduct of maintenance activities and processing work requests
- description of the process for initiating and processing the work request, including the pre-job review, approval cycle, and post-job review
- definition of the priorities used to schedule work
- determination of the impact of maintenance activities on facility operations
- work planning and scheduling
- the conduct of routine maintenance planning meetings
- requirements for personnel and equipment safety and radiological protection
- post-maintenance testing
- collection of maintenance history.

Competency 1.5

Facility maintenance management (FAC# 1.26) personnel shall demonstrate a working level knowledge of the requirements for controlling maintenance activities.

1. Supporting Knowledge and/or Skills
 - a. Discuss the elements of an effective work control program, including the following:
 1. Adherence to facility procedures, practices, and policies
 2. Work control procedures
 3. Work requests
 4. Review of completed work requests
 5. Control of temporary repairs
 6. Control of non-facility contractor and sub-contractor personnel
 7. Work site cleanliness
 8. Job briefings
 9. Control of troubleshooting
 10. Tagout/lockouts, radiological work permits, confined space permits
 11. Independent verification requirements
 12. Maintenance problem identification, correction, and evaluation
 13. Deficiency identification and correction
 14. Response to abnormal maintenance conditions
 15. Configuration control
 - b. Describe the maintenance supervisor's role and responsibilities in the supervision of maintenance activities and review of completed work requests.
2. Self-Study Information

Competency 1.5 addresses requirements for controlling maintenance activities. Competency 1.5 is at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Conduct of Operations Requirements for DOE Facilities, DOE Order 5480.19
- Guideline to Good Practices for Independent Verification, DOE-STD-1036-93
- Guideline to Good Practices for Planning, Scheduling and Coordination of Maintenance at DOE Nuclear Facilities, DOE-STD-1050-93

- Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities, DOE-STD-1053-93
- Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities, DOE-STD-1055-93
- Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities, DOE-STD-1072-94
- Guide for Operational Configuration Management Program, DOE-STD-1073-93-Pts. 1 and 2
- Independent Verification and Self-Checking, Office of Nuclear and Facility Safety, Safety Notice 95-02, DOE/EH-0502

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

a. For Supporting Knowledge and Skills **1.5-1.a** refer to:

1. Maintenance Management Program (DOE Order 4330.4B), Section 3.4.5, page I-22 and Section 6.3.5, page II-28 - II-29.
2. Maintenance Management Program (DOE Order 4330.4B), Section 3.4 and 3.4.1, page I-17 - I-19 and Section 8.3.1, pages II-46 - II-47.
3. Maintenance Management Program (DOE Order 4330.4B), Section 3.4 and 3.4.1, page I-17 - I-19 and Section 8.3.2, page II-47.
4. Maintenance Management Program (DOE Order 4330.4B), Section 8.3.4, page II-49.
5. Maintenance Management Program (DOE Order 4330.4B), Section 3.6.4, page I-39; Section 8.3.5, page II-50; and Section 18.3.2, page II-95 - II-96.
Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities (DOE-STD-1053-93), Sections 3.4.7 and 3.4.14, pages 18 and 21 - 22.
6. Maintenance Management Program (DOE Order 4330.4B), Section 8.3.6, page II-50.
Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities (DOE-STD-1053-93), Section 3.4.6, page 17.
7. Maintenance Management Program (DOE Order 4330.4B), Section 3.4.1.b.11,

page I-18; Section 3.6.3.d.5, page I-38; and Section 8.3.3, page II-49.

8. Maintenance Management Program (DOE Order 4330.4B), Section 3.4.2, page I-20; Section 3.6.3, page I-38; and Section 8.3.3, page II-48.
9. Maintenance Management Program (DOE Order 4330.4B), Section 8.2 page II-45. Guideline to Good Practices for Planning, Scheduling and Coordination of Maintenance at DOE Nuclear Facilities (DOE-STD-1050-93), Appendix F, pages F-3 - F-4.
10. Maintenance Management Program (DOE Order 4330.4B), Section 7.2, page II-32, Section 7.3.3, page II-38 - I-39; Section 8.2, page II-46; Section 8.3.1, page II-46 - II - 47; and Section 8.3.2 page II-47.
11. Conduct of Operations Requirements for DOE Facilities (DOE Order 5480.19), Attachment I, Chapter X, pages I-65 - I-71. Guideline to Good Practices for Independent Verification, DOE-STD-1036-93 Independent Verification and Self-Checking, Office of Nuclear and Facility Safety, Safety Notice, 95-02 DOE/EH-0502.
12. Maintenance Management Program (DOE Order 4330.4B), Section 10.a.5, page 8; Section 3.2.1, page I-14 - I- 15; Section 3.6.3.b, page I-38; Section 8.3.1, page II-46; Section 8.3.3, page II-48; and Section 17.2, page II-88. Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities (DOE-STD-1053-93), Section 3.4.3.o, page 15.
13. Maintenance Management Program (DOE Order 4330.4B), Section 14.3.6 - 14.3.7, pages II-78 - II-79. Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities (DOE-STD-1053-93), Section 3.4.11, page 19. Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities (DOE-STD-1072-94), Section 3.4.6 - 3.5.4, pages 11 - 14.
14. Maintenance Management Program (DOE Order 4330.4B), Section 3.6.1, page I-37. Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities (DOE-STD-1053-93), Section 3.4.3.o, page 15.
15. Maintenance Management Program (DOE Order 4330.4B), Section 8.2, page II-46. Guide for Operational Configuration Management Program (DOE-STD-1073-93-Pt.1), Glossary, page x.

b. For Supporting Knowledge and Skills **1.5-1.b** refer to:

- Maintenance Management Program (DOE Order 4330.4B), Section 3.7.4, page I-43 - I-44; Sections 8.3.3 and 8.3.4, pages II-48 - II-49; and Sections 15.2 and 15.3.1, pages II-79 - II-80.
- Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities (DOE-STD-1053-93), Section 3.4.3, pages 14 - 16.
- Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities (DOE-STD-1055-93), Sections 2.1 and 2.2.1, pages 3 - 5.

Job briefings

Work control procedures should specify if and what type of pre-job brief is required. Job Pre-Briefs are essential to the performance of quality maintenance and as such should be performed prior to all work. Additionally, they should be as a tool to help reenforce the standards expected of Maintenance Personnel. The formality and depth of a pre-brief is based on the complexity of the task, crafts/organizations involved and safety classification of the SSC involved. Pre-Briefs can be as simple as verbal direction from a First Line Supervisor to the completion of a Pre-Brief Checklist with all participants present in a formal setting.

4. Practice Exercise

- a. What are the two main levels of procedural compliance? (K&S 1.5-1.a.1)
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- b. Procedures should be checked prior to use to ensure that the most current and correct revision is being used. How can a worker determine if the procedure is the most current revision? (K&S 1.5-1.a.1)
- c. Discuss the work control procedures in an effective work control program. (K&S 1.5-1.a.2)
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d. Discuss the work requests in an effective work control program. (K&S 1.5-1.a.3)

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- e. Discuss the minimum requirements for a computer-based Maintenance Job Request (MJR) or other work control document in an effective work control program. (K&S 1.5-1.a.3)

It should include the basic capacity for the following:

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- f. In an effective work control program, who is responsible to review of completed work requests the post maintenance testing or inspection performed to determine that all work is acceptable prior to returning the structures, systems, and components (SSC) to normal service. (K&S 1.5-1.a.4) (K&S 1.5-1.b)

- g. Discuss the review of completed work requests in an effective work control program. (K&S 1.5-1.a.4) (K&S 1.5-1.b)

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- i. Discuss the control of non-facility contractor and sub-contractor personnel in an effective work control program. (K&S 1.5-1.a.6)

- j. What are some items that should be looked for at the work site prior to close out of the maintenance work order? (K&S 1.5-1.a.7)

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- k. Are formal job briefings necessary for all maintenance activities? Why or why not? (K&S 1.5-1.a.8)

- l. What information sources or documents should be consulted before developing a troubleshooting guidelines? (K&S 1.5-1.a.9)

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- m. Why must troubleshooting be controlled in an effective work control program. (K&S 1.5-1.a.9)

- n. What actions can an effective work control program address regarding tagout/lockouts, radiological work permits, confined space permits? (K&S 1.5-1.a.10)
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- o. Discuss the independent verification requirements in an effective work control program. (K&S 1.5-1.a.11)
- p. In accordance with DOE Order 4330.4B, what method is used to identify and correct discrepancies within the facility? (K&S 1.5-1.a.12)
- q. What is the purpose of the work control program? (K&S 1.5-1.a.12)
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- r. Discuss the deficiency identification and correction in an effective work control program. (K&S 1.5-1.a.13)

- s. Discuss the response to abnormal maintenance conditions in an effective work control program. (K&S 1.5-1.a.14)

- t. Define the term "**configuration management**". (K&S 1.5-1.a.15)

- u. How is configuration control maintained in an effective work control program? (K&S 1.5-1.a.15)

- v. Maintenance managers should visit the facility, including visits at irregular hours, assess selected activities and portions of the facility, and leave a _____. (K&S 1.5-1.b)

- w. One aspect of the maintenance supervisor's role and responsibilities is to observe and review the post maintenance testing process. In reviewing the post maintenance testing instructions list the items that should be clearly defined, understood, and included: (K&S 1.5-1.b)
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5. Practice Exercise Answers

- a. What are the two main levels of procedural compliance? (K&S 1.5-1.a.1)

Step-by-step compliance without deviation; and

General intent compliance.

- b. Procedures should be checked prior to use to ensure that the most current and correct revision is being used. How can a worker determine if the procedure is the most current revision? (K&S 1.5-1.a.1)

Identification markings should also be sufficient for the user to be able to compare a procedure to some centralized, controlling record to verify that the procedure is the most current revision.

- c. Discuss the work control procedures in an effective work control program. (K&S 1.5-1.a.2)

The work control procedures should describe the work request form, including applicable attachments, and should, as a minimum, address the following:

- personnel responsibility for identifying deficiencies and initiating work requests that adequately describe the symptoms or problems
- supervisory responsibility for controlling the conduct of maintenance activities and processing work requests
- description of the process for initiating and processing the work requests, including the pre-job review, approval cycle, and post-job review
- definition of the priorities used to schedule work
- determination of the impact of maintenance activities on facility operations
- work planning and scheduling
- the conduct of routine maintenance planning meetings
- requirements for personnel and equipment safety and radiological protection
- post-maintenance testing
- collection of maintenance history

d. Discuss the work requests in an effective work control program. (K&S 1.5-1.a.3)

Work control documents should control and authorize all maintenance activities. The work control document should be prepared for all work consistent with the level of detail fitting the risk/complexity/importance of the tasks involved. The document should clearly define the work to be performed and should address the following items:

- equipment identification
- name of the person initiating the job request
- date job request initiated
- description of symptom, problem, or work requested
- job priority (based upon an approved work priority system)
- personnel safety and radiation protection requirements or permits in accordance with applicable plant policies and procedures
- applicable Technical Safety Requirements, time restraints and associated Limiting Conditions for Operations
- identification of qualification requirements such as environmental and seismic qualifications
- applicable work instructions and references (including hold points for data/measurement, and inspection/checks)
- inspection, safety, or ALARA hold points associated with the work
- required post maintenance testing, inspections, and acceptance criteria
- authorization by the appropriate owner/operator and maintenance supervisor to commence work
- narrative description of conditions found and adjustments made by the craftspersons
- documentation of actual work performed with post maintenance testing and inspection results
- acceptance of the equipment by owner/operator
- cost accounting information
- final review and sign-offs by maintenance, quality control, and other groups in the job request review cycle

Maintenance conducted on equipment should be planned, controlled by written instructions or procedures, and documented using a facility maintenance job request or another approved work control document.

- e. Discuss the minimum requirements for a computer-based Maintenance Job Request (MJR) or other work control document in an effective work control program. (K&S 1.5-1.a.3)

It should include the basic capacity for the following:

- authorize the work
- track job status
- collect history information/data
- collect cost information
- management reporting

- f. In an effective work control program, who is responsible to review of completed work requests the post maintenance testing or inspection performed to determine that all work is acceptable prior to returning the structures, systems, and components (SSC) to normal service. (K&S 1.5-1.a.4) (K&S 1.5-1.b)

The operations supervision on all shifts.

- g. Discuss the review of completed work requests in an effective work control program. (K&S 1.5-1.a.4) (K&S 1.5-1.b)

Maintenance supervisors should review completed job requests for the adequacy of repair, complete documentation, and identification of rework. A post-job review should be held with the craftspersons involved. This review may be a brief discussion or an involved critique. The purpose of the review is to determine whether any unexpected problems occurred and/or how the activity may be accomplished more efficiently the next time. Other reviews should be accomplished by the technical support, quality control, radiation protection, and other organizations, as appropriate and in accordance with facility instructions. Feedback should be provided to planning, scheduling, and maintenance personnel to highlight areas that were exemplary and areas that needed improvement. Maintenance supervision, as a minimum, ensure the following:

- affected individuals/organization are kept knowledgeable of applicable lessons learned from other sources
- the identity of the individual who certifies successful completion of maintenance work is traceable
- maintenance rework is identified and regularly reviewed for implications and applicable actions to minimize recurrence
- maintenance managers and supervisors use personal observation for:
 - identifying and correcting violations
 - ensuring established policy and procedure compliance
 - conveying management expectations for standards of excellence
 - verifying that unauthorized changes or modifications do not exist
 - ensuring that design integrity of structures, systems, and components (SSC) is maintained (includes associated protective devices)

- h. Discuss the control of temporary repairs in an effective work control program. (K&S 1.5-1.a.5)

Temporary repairs are temporary modifications to the facility that allow equipment to remain in or be returned to service in a condition that is not the same as the original design specification. Prior to implementation, temporary repairs should receive a safety review in accordance with the facility temporary modification program to ensure the adequacy of the repair and its effect on personnel and equipment safety and reliability. Temporary repairs should be tracked after their completion for consideration of permanent repairs. Permanent corrective action should be taken as soon as practicable.

- i. Discuss the control of non-facility contractor and sub-contractor personnel in an effective work control program. (K&S 1.5-1.a.6)

Non-facility contractor and sub-contractor personnel who perform maintenance or modifications on facility systems should be trained and qualified for the work they are to perform. These personnel should also receive general employee training and specific training in appropriate facility administration, safety, quality control, and radiation protection procedures and practices. Adequate time should be provided for this training. Recognition should be given to individual needs and previous training experience. Experienced personnel may be allowed to bypass training by providing proficiency through examination and demonstration. Non-facility contractor and sub-contractor personnel who are not fully trained and qualified for the job to be performed should be continually supervised by qualified personnel.

Non-facility contractor and sub-contractor personnel should perform maintenance under the same controls as, and to the same high work standards expected of, facility maintenance personnel. Non-facility contractor and sub-contractor managers and supervisors should be held accountable for the work performance of their personnel. Facility supervisors should review the work of these personnel during preparation for work, at the job site, and during post maintenance testing and acceptance inspections to extent needed to enforce these requirements.

Use of sub-contractor personnel to perform routine facility maintenance should not be relied upon to the extent that it deters the development of permanent staff expertise.

- j. What are some items that should be looked for at the work site prior to close out of the maintenance work order? (K&S 1.5-1.a.7)
- safety hazards (loose wires, unsupported piping, leaking fluids, un-installed safety boundaries, etc.)
 - adrift tools and parts
 - un-installed thermal insulation
 - unlabeled components
 - obvious maintenance deficiencies (missing bolts and nuts, excessive leakage, etc.)

- k. Are formal job briefings necessary for all maintenance activities? Why or why not? (K&S 1.5-1.a.8)

Formal job briefing are not necessary for all maintenance activities. The need for a briefing is based on the complexity of the task, crafts/organizations involved and safety classification of the SSC involved. Pre-Briefs can be as simple as verbal direction from a First Line Supervisor to the completion of a Pre-Brief Checklist with all participants present in a formal setting.

- l. What information sources or documents should be consulted before developing a troubleshooting guidelines? (K&S 1.5-1.a.9)
- system engineers
 - owner/operator personnel (organization responsible for the equipment)
 - training
 - technical safety requirements
 - final safety analysis reports (FSAR)
 - equipment vendor manuals
 - equipment manufacturers
 - applicable procedures
 - applicable system/circuit drawings
 - vendor drawings

- m. Why must troubleshooting be controlled in an effective work control program. (K&S 1.5-1.a.9)

Troubleshooting must be controlled to prevent unplanned repairs and unauthorized modifications.

- n. What actions can an effective work control program address regarding tagout/lockouts, radiological work permits, confined space permits? (K&S 1.5-1.a.10)

In an effective work control program:

- Coordinating maintenance activities is necessary to help ensure that work can be effectively accomplished.
- Activities should also be grouped to accomplish as much work as possible on one tagout.
- A lead group can be assigned the maintenance activity and responsible for coordinating such activities as verifying that tagouts and permits are available as required.
- Maintenance activities requiring similar tagouts and permits could be scheduled simultaneously.

- o. Discuss the independent verification requirements in an effective work control program. (K&S 1.5-1.a.11)

Verification is a review to ensure the proper format and technical accuracy of a new or revised procedure. This review should ensure that the format incorporates human-factors principles and other administrative policies. The technical accuracy review should also include a review of the procedure against the design requirement for that system or component. This may be accomplished by comparing the vendor manual design specifications to the procedures.

Verification should be conducted by one or more reviewers who were not involved in writing the procedure. Other disciplines such as health physics and operations should be considered for the review process.

- p. In accordance with DOE Order 4330.4B, what method is used to identify and correct discrepancies within the facility? (K&S 1.5-1.a.12)

Facility Condition and Housekeeping Inspection program.

- q. What is the purpose of the work control program? (K&S 1.5-1.a.12)

The basic intent of the work control program is to:

- identify all facility deficiencies and work needed,
- to avoid redundant identification of these deficiencies,
- to guide the accomplishment of work and subsequent post maintenance activities.

- r. Discuss the deficiency identification and correction in an effective work control program. (K&S 1.5-1.a.13)

The inspector should report the results of each inspection to the inspection coordinator. Significant facility condition and safety deficiencies observed should be immediately reported to the shift supervisor for appropriate near-term attention.

If a facility deficiency tagging system is in use, the individual identifying the deficiency should attach a deficiency identification tag to the equipment or hang it in the area for non-equipment deficiencies. These tags should be removed after the deficiency has been corrected or the equipment has been functionally accepted by operations.

In addition to routine inspections, all personnel should be responsible for the prompt identification, correction (if feasible), or documentation of facility condition and housekeeping deficiencies during normal course of their duties.

A list of all deficiencies not included in the work control system or some other corrective action system with responsibility for correction or disposition of each deficiency should be prepared. Personnel assigned corrective action should periodically report results of the action planned or conducted to the inspection coordinator, and deficiencies should be tracked to completion.

Reported deficiencies should be monitored to identify recurring, generic, and long-term problems. Actions taken to resolve these problems should include a failure or root-cause analysis and not merely a correction of symptoms. DOE 4330.4B paragraph 17, Analysis of Maintenance Problems, addresses the analysis of maintenance problems.

Follow up of selected corrective action from previous inspections is necessary for evaluating the timeliness and effectiveness of the corrective action and obtaining the maximum benefit from the inspection program. Several methods may be used to accomplish this follow up.

The inspection coordinator or an assigned individual should periodically review inspection reports and actual facility conditions to evaluate the effectiveness of the inspection program. Inspection emphasis should be adjusted, as required. The review should also determine whether changes should be made to any program to reduce generic, recurring, or continuing deficiencies.

- s. Discuss the response to abnormal maintenance conditions in an effective work control program. (K&S 1.5-1.a.14)

Abnormalities found during surveillances or preventive maintenance program are immediately reported to higher authority.

- t. Define the term "**configuration management**". (K&S 1.5-1.a.15)

An integrated management program that establishes consistency among design requirements, physical configuration, and facility documentation, and maintain this consistency throughout the life of the facility as changes occur. The configuration management (CM) program consists of CM requirements, document control, change control, and assessment. The CM program also includes design reconstitution and material condition and aging management (MCA) as adjunct programs.

- u. How is configuration control maintained in an effective work control program? (K&S 1.5-1.a.15)

Configuration control is maintained by ensuring that systems and equipment are restored to their original condition following maintenance.

- v. Maintenance managers should visit the facility, including visits at irregular hours, assess selected activities and portions of the facility, and leave a written record of their observations. (K&S 1.5-1.b)

- w. One aspect of the maintenance supervisor's role and responsibilities is to observe and review the post maintenance testing process. In reviewing the post maintenance testing instructions list the items that should be clearly defined, understood, and included: (K&S 1.5-1.b)

- clearly written instructions
- specific parameter acceptance criteria
- applicable test precautions and safety considerations
- a test scope adequate to verify the adequacy of completed work
- documentation of test results/data
- test results reviewed and written acceptance by operations

Competency 1.6

Facility maintenance management (FAC# 1.27) personnel shall demonstrate a working level knowledge of planning, scheduling, and coordination of maintenance activities.

1. Supporting Knowledge and/or Skills
 - a. Discuss the importance of planning, scheduling, and coordinating maintenance activities.
 - b. Discuss the prioritization of maintenance activities.
 - c. Describe the elements of a priority system used for maintenance planning.
 - d. Define backlog.
 - e. Discuss the use of backlog as a management tool (mission, goals, budget, and staff).
 - f. Describe the elements of a system used to manage the maintenance backlog.
 - g. Understand and describe the relationship between operations and maintenance organizations. Include a discussion on resource and time requirements.
 - h. Discuss the role of planning meetings to coordinate activities.
 - i. Describe the importance of pre-briefings and what should be included in a pre-brief.
 - j. Discuss the relationship between normal maintenance and outage maintenance.
 - k. Discuss the requirements for scheduling and coordinating planned outages.
 - l. Discuss the requirements for scheduling and coordinating forced outages or other limitations to facility operations.

2. Self-Study Information

Competency 1.6 addresses planning, scheduling, and coordination of maintenance activities. Competency 1.6 is at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities, DOE-STD-1050-93
- Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93),

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- For Supporting Knowledge and Skills **1.6-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.4.2 and 3.4.6, pages I-19 - I-21, and I-24 - I-25; Section 7.2, page II-32; Section 7.3.3, page II-38 - II-39; and Section 7.3.4, page II-39 - II-43.
 - Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities, (DOE-STD-1050-93) Section 3.1.1, page 8 - 11; Section 3.1.2, page 11 - 12; Section 3.1.3, page 12 - 13; Section 3.4, page 17 - 22; Section 3.5, pages 23 - 28; and Section 3.6, pages 29 - 33.
- For Supporting Knowledge and Skills **1.6-1.b** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.4.4, page I-21 - I-22 and Section 7.3.2.b, pages II-37 - II-38.
 - Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities (DOE-STD-1050-93), Section 3.1.2, page 12.
- For Supporting Knowledge and Skills **1.6-1.c** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.4.4, page I-21 - I-22 and Section 7.3.2.b, page II-37.
 - Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities, (DOE-STD-1050-93) Section 3.1.2, page 11 - 12.

- d. For Supporting Knowledge and Skills **1.6-1.d** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Definitions, Attachment 1, Item 9, page 2.
- e. For Supporting Knowledge and Skills **1.6-1.e** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.4.8, pages I-26 - I-27 and Section 7.3.2.a, pages II-35 - II-36.
- f. For Supporting Knowledge and Skills **1.6-1.f** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.4.8, page I-26 - I-27 and Section 7.3.2.a, pages II-35 - II-36.
- g. For Supporting Knowledge and Skills **1.6-1.g** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 2.3.2.a, pages II-4 - II-5.
 - Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities (DOE-STD-1050-93), Sections 3.3.1 (Maintenance) and 3.3.2 (Operations), pages 15 - 16.
 - Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Section 2.3.9, page 11.
- h. For Supporting Knowledge and Skills **1.6-1.h** refer to:
- Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities (DOE-STD-1050-93), Section 3.1.3, pages 12 - 13; Section 3.6.2, pages 29 - 30; and Section 3.6.4, page 31.
- i. For Supporting Knowledge and Skills **1.6-1.i** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 8.3.3, pages II-48 - II-49.
- j. For Supporting Knowledge and Skills **1.6-1.j** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 7.3.4, page II-39 - II-42.
 - Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities (DOE-STD-1050-93), Section 3.1.2, page 11.
- k. For Supporting Knowledge and Skills **1.6-1.k** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 7.3.4.a, pages II-40 - II-42.

1. For Supporting Knowledge and Skills **1.6-1.1** refer to:

- Maintenance Management Program (DOE Order 4330.4B), Section 7.3.4.b, pages II-42 - II-43.

Discuss the use of backlog as a management tool (mission, goals, budget, and staff).

Maintenance Backlog, as discussed in Maintenance Management Program (DOE Order 4330.4B), is a key indicator of maintenance organization health. An increasing backlog could be an indication of poor maintenance quality (rework) or decreasing facility material condition due to aging. By utilizing trending and root cause analysis techniques, the data gained can be used to predict training, staffing and budget needs. This information can also be used, from a historical perspective, to predict expected changes due to a change in mission.

Discuss the role of planning meetings to coordinate activities.

The most important point to remember with respect to this relationship is that Maintenance is a support organization whose most important customer is Operations. Keeping this fact in perspective will lead to a clearer understanding of the maintenance role.

Describe the importance of pre-briefings and what should be included in a pre-brief.

Job Pre-Briefs are essential to the performance of quality maintenance and as such should be performed prior to all work. Additionally, they should be as a tool to help reenforce the standards expected of Maintenance Personnel. The formality and depth of a pre-brief is based on the complexity of the task, crafts/organizations involved and safety classification of the SSC involved. Pre-Briefs can be as simple as verbal direction from a First Line Supervisor to the completion of a Pre-Brief Checklist with all participants present in a formal setting.

"Lessons Learned" information should always be included in Pre-Briefs. Maintenance Management Program (DOE Order 4330.4B), Section 8.3.3, pages II-48 - II-49 contains other information that should be considered for inclusion during a Pre-Briefs.

Discuss the relationship between normal maintenance and outage maintenance.

The basic difference between normal maintenance and outage maintenance is the plant conditions required to support the performance of each. In general, normal maintenance can be performed, as the name implies, during normal plant operations. On the other hand, outage maintenance requires plant conditions that are either unique or of significant duration. The references identified above present information on this subject from a scheduling perspective.

a. Discuss the importance of planning maintenance activities. (K&S 1.6-1.a)

b. Discuss the importance of scheduling maintenance activities. (K&S 1.6-1.a)

c. List examples of areas where interdepartmental coordination is necessary. (K&S 1.6-1.a)

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d. Who is assigned the lead in identifying and coordinating needed support to accomplish maintenance activities. (K&S 1.6-1.a)

- e. Describe the attributes of an effective schedule for maintenance activities. (K&S 1.6-1.a)

The following are some of the attributes that should be included in the schedule:

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- f. Discuss the prioritization of maintenance activities. (K&S 1.6-1.b)

- g. Complete the following table regarding a typical priority system for a reactor facility.
(K&S 1.6-1.b)

NON-OUTAGE WORK			
Classification		Limitation	Scheduling
Priority 1			
Priority 2			
Priority 3			
Priority 4	XXX	XXX	

OUTAGE WORK			
Classification		Limitation	
Priority 5	XXX		XXX
Priority 6	XXX		XXX

- h. One method to assist in the prioritization of maintenance activities is to develop a priority coding system. Define the following priority coding terms: (K&S 1.6-1.b)
- *Critical (C)*

 - *Urgent (U)*

 - *Priority (P)*

 - *Routine (R)*
- i. Describe the elements of a priority system used for maintenance planning. (K&S 1.6-1.c)
- Items that should be considered when assigning priorities to work requests include the following:
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- j. Define backlog. (K&S 1.6-1.d)

- k. Discuss the use of backlog as a management tool (mission, goals, budget, and staff).
(K&S 1.6-1.e)

- l. Describe the elements of a system used to manage the maintenance backlog. (K&S
1.6-1.f)

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- m. Understand and describe the relationship between operations and maintenance organizations. Include a discussion on resource and time requirements. (K&S 1.6-1.g)

- n. Discuss the role of planning meetings to coordinate activities. (K&S 1.6-1.h)

- o. Match the characteristics of a type of maintenance meeting in column A with the type of maintenance meeting in column B. The column B answers **MAY BE** used **MORE** than one time. Ignore any response in column B not identified in column A. (K&S 1.6-1.h)

Column A	Column B
___ 1. Focuses on the major jobs and evolutions planned for the next 48 hours	a. Daily directional meeting
___ 2. The meeting should end in time for supervisors to return to their work groups before the shift starts.	b. Daily planning meeting
___ 3. Focuses on the near term (next three to five days) schedule and verify that jobs may be worked as scheduled	c. Shift work coordination meeting
___ 4. Each attendee should leave the meeting with a clear understanding of what their work group should do on the upcoming shift	d. Maintenance outage meeting
p. What information should be included in a pre-brief? (K&S 1.6-1.i)	
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- q. List the items that should be included on the outage initial milestone when scheduling and coordinating planned outages. (K&S 1.6-1.k)
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- r. When should the outage planning and scheduling for major outage activities commence? (K&S 1.6-1.k)
- s. What items should be included on the outage schedule to identify and allocate critical resources for scheduling and coordinating forced outages. (K&S 1.6-1.l)
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- t. What tasks should be considered when developing an outage schedule. (K&S 1.6-1.1)
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- u. In addition to planning and scheduling forced outages or other limitations to facility operations, what actions can be taken to facilitate the accomplishment of the outage.
(K&S 1.6-1.1)

5. Practice Exercise Answers

- a. Discuss the importance of planning maintenance activities. (K&S 1.6-1.a)

Planning for work is an important part of the maintenance process. In-depth work planning identifies the required support and detailed scoping necessary to accurately schedule daily maintenance. Defining the work to be performed and providing appropriate procedures or instructions can reduce maintenance errors. Assigning work priorities that reflect the relative importance of each job to facility operation maximizes the effect of maintenance in upgrading safety and reliability. Planning also reduces delays in accomplishing work by ensuring support items such as special tools, other equipment, and repair parts and materials required to accomplish the work are available when needed. This, in turn, results in increased efficiency and contributes to maintaining a higher level of facility condition.

- b. Discuss the importance of scheduling maintenance activities. (K&S 1.6-1.a)

Scheduling of corrective and preventive maintenance and of planned and force outage work is necessary to ensure that maintenance is conducted efficiently and within prescribed time limits. Scheduling daily activities based on accurate planning estimates will improve the use of time on the job and help reduce radiological exposure. Scheduling of planned outages is important to support the return of the facility to service on schedule (and within the approved budget) and results in improved availability and capacity factors. A contingency schedule should be maintained so that if a forced outage occurs, the forced outage time is minimized and effectively used and that needed maintenance is performed prior to restart.

- c. List examples of areas where interdepartmental coordination is necessary. (K&S 1.6-1.a)

- preparing and using safe work permits (SWP)
- radiation work permits (RWP)
- fire or burn permits
- entering confined spaces
- equipment clearance tagouts
- quality control verifications.

- d. Who is assigned the lead in identifying and coordinating needed support to accomplish maintenance activities. (K&S 1.6-1.a)

A planner, supervisor, or a designated individual within the maintenance organization or within group responsible for the major portion of the job.

- e. Describe the attributes of an effective schedule for maintenance activities. (K&S 1.6-1.a)

The following are some of the attributes that should be included in the schedule:

- The schedule should be useful. The individuals expected to follow the schedule need to understand that it should make their tasks and the tasks of other easier. They should also understand the importance of their tasks in relation to the schedule as a whole.
- The schedule report format should be appropriate for the user. The level of detail needed by the plant manager is different from the level of detail needed by a craft supervisor.
- The schedule should be proactive, in that it should predict and lead activities and not be an historical document.
- The schedule should be credible. It should be based on the best information available and reviewed and accepted by those actually responsible for doing the work.
- The schedule should be up to date. The schedule should be updated to reflect changing situations to maintain credibility. An out-of-date schedule often may be worse than no schedule.
- The schedule should be flexible, within the overall goals of the plant, in order, to produce optimum results in dealing with unanticipated events.
- There should be one overall schedule. The overall schedule should be developed such that a hierarchy of schedules of varying detail may be obtained from a common data base. It has generally proven difficult to keep two or more schedules consistent, even when significantly different in level of detail are shown.
- To be responsive to the needs of management, a computerized scheduling system should be used.

- f. Discuss the prioritization of maintenance activities. (K&S 1.6-1.b)

Each work request related to producing equipment repairs should be reviewed by the operations department to determine its impact on facility operations. Meaningful priorities that determine how soon a work request needs to be worked should be set based on safety and reliability. Communication among cognizant groups should be established to set priorities properly. A method should be established that avoids congesting the work control system with jobs that are not important to safe and reliable operation.

The priority system should be simple in order to enhance its use and accuracy. Typically the priority system is limited to about six categories. Corrective maintenance should be assigned a priority based on the maximum time allowed before corrective action must be taken, as well as the system or equipment importance.

- g. Complete the following table regarding a typical priority system for a reactor facility.
(K&S 1.6-1.b)

NON-OUTAGE WORK			
Classification		Limitation	Scheduling
Priority 1	Emergency or personnel safety	limits facility operation	top priority-- work today and provide special coverage if necessary
Priority 2	Urgent	hinders facility operation	schedule within 24 hours
Priority 3	Necessary	has potential to degrade or hinder facility operation	schedule within 7 days
Priority 4	XXX	XXX	as time permits

OUTAGE WORK			
Classification		Limitation	
Priority 5	XXX	hot shutdown or hot standby ¹	XXX
Priority 6	XXX	cold shutdown ¹	XXX

¹ Comparable conditions can be defined for non-reactor facilities.

- h. One method to assist in the prioritization of maintenance activities is to develop a priority coding system. Define the following priority coding terms: (K&S 1.6-1.b)
- *Critical (C)*: Equipment or systems that shall operate greater than 90% of the time. Being out of service for one working day may result in:
 - imminent and significant environmental damage
 - potential to expose personnel to serious health and safety damage, including injury or death
 - breach of security
 - interruption of production or experiment
 - *Urgent (U)*: Equipment, systems, or experiments important to plant goals and which when out of service may result in significant interruption of production or experiment. Importance is great enough to justify diverting personnel from other assignments and to work over time, based on real-time circumstances. Required uptime is greater than 80%.
 - *Priority (P)*: Equipment, systems, or experiments important to plant goals but which have backup or redundant hardware. Required uptime is greater than 70%.
 - *Routine (R)*: Equipment, systems, or experiments not meeting one of the above categories which may be worked in most economical manner.
- i. Describe the elements of a priority system used for maintenance planning. (K&S 1.6-1.c)
- Items that should be considered when assigning priorities to work requests include the following:
- personnel and radiological safety
 - equipment repair urgency
 - operability of redundant equipment
 - operating approval commitments (e.g., Technical Safety Requirements)
 - facility conditions required for equipment repair
 - repair or replacement parts status
 - ALARA considerations
 - personnel availability
 - minimizing the spread of contamination from leaks
- j. Define backlog. (K&S 1.6-1.d)
- The amount of maintenance and repair work not accomplished that is needed or planned to sustain the assigned mission.

- k. Discuss the use of backlog as a management tool (mission, goals, budget, and staff). (K&S 1.6-1.e)

Maintenance backlog should be monitored to ensure that the condition of the property is maintained consistent with the facility's mission. By using the maintenance backlog (estimated work-hours and the number of work requests) management can make recommendation regarding staffing. Monitoring the backlog can be used to ensure that the proper priority is given to facility conditions important to safety, environment, and facility mission. Management must document and justify deferred critical facility maintenance work. Backlog is managed on the basis of prioritization. Budget and staffing levels are evaluated against both the planned maintenance and the amount of work in the backlog.

Maintenance backlog should be monitored to help ensure that important jobs are not being necessarily delayed and control is maintained over the amount of work in the backlog.

- l. Describe the elements of a system used to manage the maintenance backlog. (K&S 1.6-1.f)

The system should provide a serialized list of work requests with a brief description of the work required, priority assigned, date the work request was initiated, and facility conditions required to perform the work. Features of the system that could be helpful in managing the maintenance backlog include the following:

- a computerized system with the ability to sort work requests by:
 - priority
 - work request date
 - facility conditions
 - systems affected.
- a status of all work requests on hold for:
 - planning
 - parts
 - material
 - other constraints
- a tracking system to maintain the status of all work requests currently being worked
- a tracking system to ensure that all required post-maintenance testing is accomplished prior to the return of a piece of equipment or a system to service

- m. Understand and describe the relationship between operations and maintenance organizations. Include a discussion on resource and time requirements. (K&S 1.6-1.g)

Maintenance personnel should clearly understand their authority, responsibility, accountability, and interfaces with other groups.

Maintenance division staff interface with many outside organizations, such as the bargaining unit, federal regulatory agencies, state regulatory agencies and commissions, local governmental bodies, industry oversight and advisory groups, and insurance companies.

Maintenance division management should not acquiesce to outside organizations to the extent that management's primary responsibility - personnel safety and plant safety and reliability - is compromised.

Each facility should develop an integrated approach to maintenance so that working relationships are developed among all organizational units that support the maintenance function (e.g., operations, health physics, stores, quality control, engineering, and procurement).

The maintenance strategy should chart the relationship among these supporting groups, as related to overall facility maintenance, by defining responsibility, authority, and accountability. This will entail identification of:

- personnel interfaces
- periodic self-assessments of work activities
- procedural interfaces
- indicators relating to support of maintenance tracked for each supporting group (e.g., number of plant work orders on hold because of lack of spare parts).

- n. Discuss the role of planning meetings to coordinate activities. (K&S 1.6-1.h)

Well managed planning and scheduling meetings are necessary to keep facility personnel aware of significant maintenance activities that are in progress and to make corrections to schedules. Meetings should be effectively managed to limit the time personnel spend in the meetings. Participation in meetings should be limited to those personnel affected. Three types of meetings (daily directional meeting, planning meeting, and shift work coordination meeting) have been shown to be effective in improving communications among work groups and in enhancing job coordination.

Daily meetings, with affected individuals, should be conducted to focus on the progress of key jobs and to provide short-range coordination of scheduled activities. Meetings should be managed to efficiently use the time of the managers and

supervisors, to minimize redirection of work progress, and to prevent delays to oncoming shifts. Care should be taken to ensure that meetings focus on problems and their solutions and do not become a forum for exchange of status only.

- o. Match the characteristics of a type of maintenance meeting in column A with the type of maintenance meeting in column B. The column B answers **MAY BE** used **MORE** than one time. Ignore any response in column B not identified in column A. (K&S 1.6-1.h)

Column A	Column B
a 1. Focuses on the major jobs and evolutions planned for the next 48 hours	a. Daily directional meeting
c 2. The meeting should end in time for supervisors to return to their work groups before the shift starts.	b. Daily planning meeting
b 3. Focuses on the near term (next three to five days) schedule and verify that jobs may be worked as scheduled	c. Shift work coordination meeting
c 4. Each attendee should leave the meeting with a clear understanding of what their work group should do on the upcoming shift	d. Maintenance outage meeting
p. What information should be included in a pre-brief? (K&S 1.6-1.i)	
<ul style="list-style-type: none"> • industrial safety and radiological protection hazards • quality of workmanship, material, and parts • procedural use, adherence to step-by-step requirements, signoffs, and work hold points • open system and component protection • accountability of tools, chemicals, and materials • correct tool use • clean and orderly sites • work progress and time requirements • identifying correct component, system, or unit • requirements for post-job reporting, testing, and critiques • lesson learned information 	

- q. List the items that should be included on the outage initial milestone when scheduling and coordinating planned outages. (K&S 1.6-1.k)
- identification of major jobs
 - letting of bids for contracts and materials
 - identification of corrective maintenance, preventive maintenance, surveillance, and in-service test requirements
 - identification of major modification, dates for design work, work package preparation, and procurement of material, parts, and services
 - identification of pre-outage work that can and should be performed to reduce the demand for resources during the outage
 - identification of facilities required for outage support and milestones for their construction
 - staging of special tools and equipment and preparation of work areas
 - development of schedules
- r. When should the outage planning and scheduling for major outage activities commence? (K&S 1.6-1.k)
- No later than immediately following that unit's completion of the current outage. Planning and scheduling for major maintenance activities and modifications may have to be planned several years in advance depending on the complexity of the effort. A designated outage manager or coordinator should be assigned to direct preparations for and management of the outage.
- s. What items should be included on the outage schedule to identify and allocate critical resources for scheduling and coordinating forced outages. (K&S 1.6-1.l)
- personnel
 - shop facilities
 - cranes
 - equipment accessibility
 - person-rem exposure
 - availability and scheduling of outside subcontractors and non-facility contractor groups.
- t. What tasks should be considered when developing an outage schedule. (K&S 1.6-1.l)
- corrective maintenance
 - modifications
 - surveillance
 - preventive maintenance
 - special items
 - commitments that must be performed under a system or facility outage condition or power reduction.

- u. In addition to planning and scheduling forced outages or other limitations to facility operations, what actions can be taken to facilitate the accomplishment of the outage.

(K&S 1.6-1.1)

To the extent possible, an up-to-date list of prioritized outage procedures, repair parts and materials, special tools, clearance boundaries, and personnel entry forms should be prepared.

Competency 1.7

Facility maintenance management (FAC# 1.28) personnel shall demonstrate a working level knowledge of industrial property management practices as related to stores, spare parts, and essential materials.

1. Supporting Knowledge and/or Skills

- a. Discuss how component availability impacts plant reliability and safety.
- b. Discuss the concerns related to maintaining inventory of critical components that affect limiting conditions of operations.
- c. Describe the following terms as they relate to procurement:
 - Just-in-time
 - Shelf life
 - Long lead time
- d. Describe the Department's procurement process.
- e. Describe controls that should be developed and maintained throughout the procurement process.

2. Self-Study Information

Competency 1.7 addresses industrial property management practices as related to stores, spare parts, and essential materials. Competency 1.7 is at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Guideline to Good Practices for Types of Maintenance Activities at DOE Nuclear Facilities, DOE-STD-1052-93
- Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities, DOE-STD-1071-94
- Federal Acquisition Regulations Manual (FAR)
- Department of Energy Acquisition Regulations Manual (DEAR)

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.7-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.5.2 and 3.5.3, page I-30 - I-32 and Section 10.2, page II-56.
- b. For Supporting Knowledge and Skills **1.7-1.b** refer to:
 - Maintenance Management Program, (DOE Order 4330.4B), Section 11.3.3, pages II-61 - II-62.
 - Guideline to Good Practices for Types of Maintenance Activities at DOE Nuclear Facilities (DOE-STD-1052-93), Section 3.4.4.6, page 18.
 - Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities (DOE-STD-1071-94), Section 3.4.3, pages 8 - 12.
- c. For Supporting Knowledge and Skills **1.7-1.c** refer to:
 - 1. Guideline to Good Practices for Types of Maintenance Activities at DOE Nuclear Facilities (DOE-STD-1052-93), Section 3.4.4.1, page 13.
 - 2. Maintenance Management Program (DOE Order 4330.4B), Section 11.3.3, page II-62.
Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities (DOE-STD-1071-94), Section 2.6, page 3.
 - 3. Maintenance Management Program (DOE Order 4330.4B), Section 10.3.2, page II-57.
- d. For Supporting Knowledge and Skills **1.7-1.d** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.5.2, page I-30 - I-31 and Section 10.3.1, page II-57.
 - Federal Acquisition Regulations Manual (FAR).
 - Department of Energy Acquisition Regulations Manual (DEAR).
- e. For Supporting Knowledge and Skills **1.7-1.e** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.5.3, page I-31 - I-32 and Section 10.3.3, page II-57 - II-59.

Discuss the concerns related to maintaining inventory of critical components that affect limiting conditions of operations.

- Timely repairs to Limiting Conditions of Operation (LCO) related equipment is essential to prevent failures or prolonged failures that could impact safety or lead to a Limiting Condition for Operation and therefore limit facility operation. The discussion found in DOE-STD-1052-93.

Just-in-time

- These are parts which can be ordered to support repairs prior to a component failure. This method of procurement strategy helps to reduce the cost of maintaining an inventory. A short discussion of "just-in-time" planned maintenance can be found in DOE-STD-1052-93.

Describe the Department's procurement process.

- The overall government procurement process is described in the Federal Acquisition Regulations Manual (FAR). These regulations are implemented by the Department through the Department of Energy Acquisition Regulations Manual (DEAR). At the Field Office and O&M Contractor level site specific procedures are developed based on requirements presented in the FAR and DEAR.

4. Practice Exercise

a. Discuss how component availability impacts plant reliability and safety. (K&S 1.7-1.a)

b. Discuss the concerns related to maintaining inventory of critical components that affect limiting conditions of operations. (K&S 1.7-1.b)

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c. Define the following terms as they relate to procurement: (K&S 1.7-1.c)

1. Just-in-time-

2. Shelf life -

3. Long lead time -

d. Describe the Department's procurement process. (K&S 1.7-1.d)

- e. Describe controls that should be developed and maintained throughout the procurement process. (K&S 1.7-1.e)

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5. Practice Exercise Answers

- a. Discuss how component availability impacts plant reliability and safety. (K&S 1.7-1.a)
- Having the correct part, material or service available when needed to complete a maintenance activity should be the fundamental objective of an effective procurement program. This objective is accomplished by establishing clearly defined policies and procedures and by implementing the program thus defined. Controls on and assessments of procurement activities are used to help ensure that the proper parts, materials, and services are purchased to support maintenance activities and to meet the requirements for safe and reliable facility operations.
- b. Discuss the concerns related to maintaining inventory of critical components that affect limiting conditions of operations. (K&S 1.7-1.b)
- Material and equipment should be stored in a manner that provides:
 - maximum protection
 - ready availability for the intended use
 - due consideration for environmental conditions
 - the ability to provide necessary preventative maintenance as appropriate
 - controlled personnel access
 - A shelf life control program should be provided for stores items that are important to safe and reliable facility operation. Items with finite storage lifetimes should be tracked so that stock that has exceeded its shelf life is not issued.
 - Material and equipment should be stored by intended end use to prevent inadvertent use of the wrong category of item. If segregation is not practical, marking or tagging techniques should be developed to preclude use of the wrong material or equipment.
 - A method should be established to identify parts or materials that are designated for maintenance activities or modifications.
 - Items placed into or removed from stores should be promptly documented so that the stores inventory accurately reflects current status. The stores record system should also indicate the location of items in the warehouse, stores, issue room, or other designated storage areas.
 - Provisions should be made for "minimum\maximum" lists for parts, materials, and equipment and for prompt reordering when the minimum limit has been reached. These limits should reviewed periodically and adjusted based on usage, maintenance experience, cost, and leadtime.

c. Define the following terms as they relate to procurement: (K&S 1.7-1.c)

1. Just-in-time-

Although not procedurally defined, just-in-time refers to parts which can be ordered to support repairs prior to a component failure. This method of procurement strategy helps to reduce the cost of maintaining an inventory.

2. Shelf life -

A specific period or interval of time after which a stored item may not meet its original design specifications, quality, or manufacture requirements.

3. Long lead time -

Although not procedurally defined, long lead time refers to need to order a part a long time before it is needed for maintenance or repairs. The component or part must be ordered with sufficient time for the manufacturer or supplier to fabricate or obtain.

d. Describe the Department's procurement process. (K&S 1.7-1.d)

Policy should be established for the procurement of parts, materials, and services. These policies must be understood by stores and purchasing personnel and other personnel who interface with the stores an purchasing operation, such as maintenance supervisors, planning, and scheduling personnel.

Procedures should be prepared to specifically describe the responsibilities of personnel involved in the procurement function. Specific procurement actions should be included in these procedures.

A system should be established as parts of the design change process to update spare parts needs and remove outdated/obsolete materials from the stock system.

- e. Describe controls that should be developed and maintained throughout the procurement process. (K&S 1.7-1.e)

Controls should be developed and maintained throughout the procurement process to help obtain parts, materials and services in a timely manner. Controls such as the following should be provided:

- Reliability of supplier performance should be verified. This can be accomplished by audits, inspections, or surveillance of supplier facilities, processes, methods, or records relevant to the part, material or service provided.
- Deficient or nonconforming items should be resolved in an effective and timely manner. Technical reviews should be initiated promptly to aid in the resolution of these items.
- Quality assurance records need to be controlled and maintained to provide documentation for qualified parts and materials and to ensure traceability of parts and materials.
- A process should be provided to qualify non-qualified material. An effective upgrade process will result in improved availability of quality parts and materials.
- A process for acceptable substitution should be provided to obtain parts that are no longer available from the original supplier, that have new identification numbers, or that have different material specifications.
- Design requirements should be reviewed by appropriate personnel to ensure that upgrade or substitute parts are consistent with the application of the part and component. Retrievable documentation should exist to support the identification of inspection and testing requirements necessary to ensure the qualification and acceptability of the part.
- Emergency procurement and an expediting process should be developed to obtain parts, materials, and services that are needed immediately to support safe and reliable operation. Due dates should be clearly identified for parts, materials, or services that require emergency procurement.
- A parts and materials reorder system should be established that assures material availability for anticipated usage while minimizing unnecessary inventory.
- Multiple applications of requested parts or materials should be identified; use of specific parts or materials in more than one piece of equipment or system should be considered as part of the procurement and stocking process,
- The procurement organization should be able to track procumbent progress and take necessary measures to meet maintenance and outage schedules.

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Competency 1.8

Facility maintenance management (FAC# 1.29) personnel shall demonstrate a working level knowledge of the control and calibration of measuring and test equipment.

1. Supporting Knowledge and/or Skills
 - a. Discuss the elements that are included in a comprehensive measuring and test equipment program.
 - b. Describe the guidelines for the identification of measuring and test equipment.
 - c. Discuss the following aspects of calibration as they relate to measuring and test equipment:
 - Calibration standards
 - Calibration procedures
 - Calibration frequency
 - Functional checks
 - d. Describe the four-to-one rule.
 - e. Discuss the requirements for the control of measuring and test equipment.
 - f. Discuss the storage, segregation, and labeling of measuring and test equipment.
 - g. Describe the methods used for resolving out-of-calibration equipment.
 - h. Discuss the issuance and recall of measuring and test equipment.
 - i. Describe the actions taken for contaminated measuring and test equipment.
 - j. Discuss the guidelines for the evaluation of measuring and test equipment.

2. Self-Study Information

Competency 1.8 addresses control and calibration of measuring and test equipment.
Competency 1.8 is at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities, DOE-STD-1054-93
- IEEE Standard Requirements for the Calibration and Control of Measuring and Test Equipment Used in the Construction Nuclear Facilities¹ IEEE Std. 498-1990, Institute of Electrical and Electronic Engineers, Inc.
- Control and Calibration of Measuring and Test Equipment (M&TE), INPO 84-006 (Good Practice MA-303)

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.8-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.5.4, page I-32 - I-34 and Section 12.2, pages II-64 - II-65.
 - Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities (DOE-STD-1054-93), Section 3.1, pages 5 - 6.
- b. For Supporting Knowledge and Skills **1.8-1.b** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.5.4, page I-32 - I-34 and Section 12.3.1, pages II-65 - II-66.
 - Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities (DOE-STD-1054-93), Section 3.4.2, pages 7 - 8.

¹ This standard was withdrawn in 1995. It is superseded by Nuclear Power Collection IEEE-1990.

- c. For Supporting Knowledge and Skills **1.8-1.c** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 12.3.2, pages II-66 - II-67.
 - Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities (DOE-STD-1054-93), Section 3.4.4, pages 13 - 15.
- d. For Supporting Knowledge and Skills **1.8-1.d** refer to:
- IEEE Standard Requirements for the Calibration and Control of Measuring and Test Equipment Used in the Construction Nuclear Facilities (IEEE Std. 498-1990), Section 5.1, page 10.
- e. For Supporting Knowledge and Skills **1.8-1.e** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 12.3.3, pages II-67 - II-69.
 - Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities (DOE-STD-1054-93), Section 3.4.3.5, pages 11 - 12.
- f. For Supporting Knowledge and Skills **1.8-1.f** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 12.3.3, pages II-67 - II-69.
 - Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities (DOE-STD-1054-93), Sections 3.4.3.1 and 3.4.3.2, pages 9 - 10.
- g. For Supporting Knowledge and Skills **1.8-1.g** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.5.4, page I-32 - I-34 and Section 12.3.4.a, pages II-69 - II-70.
 - Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities (DOE-STD-1054-93), Section 3.4.5, pages 15 - 16.
- h. For Supporting Knowledge and Skills **1.8-1.h** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.5.4, page I-32 - I-34 and Section 12.3.3.d, pages II-68 - II-69.
 - Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities (DOE-STD-1054-93), Section 3.4.3.4, page 11.

- i. For Supporting Knowledge and Skills **1.8-1.i** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 12.3.3.e, page II-69.

- j. For Supporting Knowledge and Skills **1.8-1.j** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 12.3.4.b, page II-70 and Section 15.3.4.d, page II-84.

4. Practice Exercise

- a. Discuss the elements that are included in a comprehensive measuring and test equipment (M&TE) program. (K&S 1.8-1.a)

A comprehensive M&TE program should include the following elements:

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- b. Describe the guidelines for the identification of measuring and test equipment (M&TE). (K&S 1.8-1.b)

- c. Describe the use of the master list for controlling measuring and test equipment (M&TE), including information that should be included on the list. (K&S 1.8-1.b)

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- d. Concerning the field use of calibration standards: (K&S 1.8-1.c)
- 1) The responsible supervisor can permanently assign a calibration standard to an individual for field use.
 - 2) Field use of calibration standards is unauthorized under all conditions.
 - 3) Calibration standards can be used in the field as long as the end use individual signs for the calibration standard.
 - 4) Field use should be authorized by the responsible supervisor and the period of issue should be minimized.
- e. Which of the following is the correct way to designate acceptance criteria for
- 1) 1.0 inches of water ± 0.5 inches of water
 - 2) 0.5 - 1.5 inches of water
 - 3) 1.0 inches of water ± 10.0 percent
 - 4) 1.0 inches of water ± 1.0 inches
- f. What should be used to determine the calibration frequency of M&TE? (K&S 1.8-1.c)
- Calibration frequency should be determined based:
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- g. What is the name of the general type of test performed on an M&TE instrument in the field before and after it is used in the field? (K&S 1.8-1.c)

h. Describe the four-to-one rule. (K&S 1.8-1.d)

i. Discuss the requirements for the control of measuring and test equipment (M&TE).
(K&S 1.8-1.e)

The control process used for M&TE should be a well established Recall Program containing as a minimum the following controls:

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j. Discuss the storage of measuring and test equipment (M&TE). (K&S 1.8-1.f)

k. Discuss the segregation of measuring and test equipment (M&TE). (K&S 1.8-1.f)

l. Discuss the labeling of measuring and test equipment (M&TE). (K&S 1.8-1.f)

m. Describe the methods used for resolving out-of-calibration equipment (M&TE).
(K&S 1.8-1.g)

n. Discuss the issuance of measuring and test equipment (M&TE). (K&S 1.8-1.h)

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o. Discuss the recall of measuring and test equipment (M&TE). (K&S 1.8-1.h)

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p. Describe the actions taken for contaminated measuring and test equipment (M&TE).
(K&S 1.8-1.i)

q. Discuss the guidelines for the evaluation of measuring and test equipment (M&TE).
(K&S 1.8-1.j)

5. Practice Exercise Answers

- a. Discuss the elements that are included in a comprehensive measuring and test equipment (M&TE) program. (K&S 1.8-1.a)

A comprehensive M&TE program should include the following elements:

- All M&TE should have unique identification numbers that accurately identify the specific devices and provides positive traceability.
- A master list identifying all M&TE should be developed and kept current.
- The M&TE calibration program must be based upon standards that are traceable to national standards or that are recognized standards unto themselves.
- Procedures should be used to calibrate M&TE to help control the performance of calibration, provide repeatable calibrations, and provide acceptance criteria,
- M&TE should be functionally checked, when applicable.
- Facilities should be provided to control storage, issue, and calibration of M&TE.
- M&TE with suspected or actual deficiencies should be segregated and marked to prohibit its use.
- M&TE devices that are not fully calibrated or usable should be clearly marked to indicate their limitations.
- M&TE issues should be include records for accountability and traceability of use. A recall system should be developed for re-calibration.
- A maintenance policy that minimizes contamination of M&TE should be developed.
- M&TE devices found out of calibration or defective should receive timely evaluations to determine the validity of all measurements and/or calibrations for which they were used.
- M&TE reliability problems should be trended to determine any corrective actions needed.
- Reviews to determine that the control of M&TE is effective should be periodically conducted.

- b. Describe the guidelines for the identification of measuring and test equipment (M&TE). (K&S 1.8-1.b)

Each piece of M&TE should be assigned a unique identification number that is permanently marked on or attached to the M&TE (the identification number may consist of the manufacturer's serial number).

- c. Describe the use of the master list for controlling measuring and test equipment (M&TE), including information that should be included on the list. (K&S 1.8-1.b)

Each department should maintain a master inventory list of the applicable M&TE covered by this program. A standards laboratory should maintain a plant level master list of applicable M&TE. These listings should include the following information for each item:

- systems/stations number - this identifies a specific document which establishes parameters, ranges, precision, accuracy, and other requirements for application of the individual item listed.
- unique number
- date of last calibration
- expiration date
- applicable procedure number
- building/location
- cost collection account
- noun description owner organization
- calibration interval

A master list of all controlled M&TE should be maintained. If separate organizations control their own M&TE, each organization should maintain or have access to a list of its own equipment. Lists should include the following, as a minimum:

- Generic description of equipment, trade or marketing name of equipment, manufacturer, model, and serial number
- unique identification number
- equipment range(s) and accuracy
- calibration procedure
- calibration frequency
- responsible organization or person.

- d. Concerning the field use of calibration standards: (K&S 1.8-1.c)
- 1) The responsible supervisor can permanently assign a calibration standard to an individual for field use.
 - 2) Field use of calibration standards is unauthorized under all conditions.
 - 3) Calibration standards can be used in the field as long as the end use individual signs for the calibration standard.
 - 4) Field use should be authorized by the responsible supervisor and the period of issue should be minimized.
- e. Which of the following is the correct way to designate acceptance criteria for
- 1) 1.0 inches of water \pm 0.5 inches of water**
 - 2) 0.5 - 1.5 inches of water
 - 3) 1.0 inches of water \pm 10.0 percent
 - 4) 1.0 inches of water \pm 1.0 inches
- f. What should be used to determine the calibration frequency of M&TE? (K&S 1.8-1.c)
- Calibration frequency should be determined based:
- on the manufacturer's recommendations
 - M&TE usage
 - M&TE historical reliability
 - consideration should be given to the amount and type of M&TE available for use compared to the M&TE needed to support peak activity periods such as outages
- g. What is the name of the general type of test performed on an M&TE instrument in the field before and after it is used in the field? (K&S 1.8-1.c)
- Operational tests, functional check, or battery check.

h. Describe the four-to-one rule. (K&S 1.8-1.d)

Reference standards used to calibrate M&TE shall have a minimum accuracy four times greater than the M&TE being calibrated. The accuracy requirement is satisfied when the M&TE is calibrated by a reference standard with a minimum 4:1 higher accuracy ratio. The reference standard must also be traceable through a series of calibrations using reference standards also of 4:1 greater accuracy, back to the National Institute of Standards and Technology (NIST) or other appropriate governing laboratory standard.

i. Discuss the requirements for the control of measuring and test equipment (M&TE). (K&S 1.8-1.e)

The control process used for M&TE should be a well established Recall Program containing as a minimum the following controls:

- Total inventory listing
- calibration DUE notices - weekly
- Individual automatic job opener and information cards
- calibration OVERDUE notices - weekly
- exception report for program errors
- scheduled and nonscheduled action history reporting

j. Discuss the storage of measuring and test equipment (M&TE). (K&S 1.8-1.f)

Facilities are required to ensure that M&TE is protected from damage in storage, is properly maintained, and is readily available (DOE 4330.4B paragraph 4 Maintenance Facilities, Equipment, and Tools). M&TE devices that are relatively easy to damage when transporting and handling should be provided with addition protection by boxing or special mounting rigs.

Department M&TE storage areas should be authorized by the maintenance manager. All equipment should be stored in a manner that assures integrity is maintained and unintended contamination is minimized. Equipment in these storage area should be identified as to its current status. The M&TE storage areas should provide sufficient separation of the ready-to-use equipment from other equipment to preclude inadvertent use.

The environment of the M&TE storage area should be controlled to preclude any adverse effect on equipment accuracy. Environmental factors that should be considered include, but are not limited to, Temperature, humidity, vibration, radio frequency interference, electromagnetic interference, and fumes.

Chapter Measuring and Test Equipment

Security of the M&TE storage area should be maintained by designated individuals responsible for control of M&TE. In the absence of these individuals, the storage area should be locked with access controlled by the responsible department manager and/or supervisor.

- k. Discuss the segregation of measuring and test equipment (M&TE). (K&S 1.8-1.f)
M&TE in the issue area should be segregated from defective, out-of-calibration, or other M&TE requiring investigation so that only calibrated M&TE is available for issue. This should be a physically and distinctively marked separation.
- l. Discuss the labeling of measuring and test equipment (M&TE). (K&S 1.8-1.f)
Each piece of M&TE should be assigned a unique identification number that is permanently marked on or attached to the M&TE (the identification number may consist of the manufacturer's serial number).

Labeling can include a calibration stickers on each M&TE device. If used, such a sticker should be attached to the M&TE device designating, as a minimum, the date the re-calibration is due.

- m. Describe the methods used for resolving out-of-calibration equipment (M&TE). (K&S 1.8-1.g)

When an M&TE device is found or suspected to be out of calibration, defective, or otherwise unreliable, an evaluation of the instruments and equipment a particular device has measured or tested since the M&TE was last calibrated should be performed promptly to determine whether re-calibration or rework is needed.

Records of field instruments calibrated by the M&TE should be reviewed to determine whether re-calibrating is necessary.

- n. Discuss the issuance of measuring and test equipment (M&TE). (K&S 1.8-1.h)
One or more controlled issue points should be provided to help ensure that only qualified persons are allowed access to M&TE. Traceability of M&TE should be provided to support a timely evaluation of instruments, systems, and other equipment associated with M&TE found to be deficient. This can be accomplished by recording:
- the M&TE user
 - when the equipment was used
 - what instrument or equipment it was used on and what purpose
 - what ranges were used or values were read.
- Maintenance history that can be readily sorted by specific M&TE used to perform maintenance is an alternate method for providing traceability.

- o. Discuss the recall of measuring and test equipment (M&TE). (K&S 1.8-1.h)

A recall system should be implemented to ensure that M&TE devices are removed from service prior to or at the expiration of their calibration. This recall system can be enhanced by the use of calibration stickers on each M&TE device. If used, such a sticker should be attached to the M&TE device designating, as a minimum, the date the re-calibration is due. The recall system should stagger calibration due dates to meet M&TE needs for peak use periods such as outages, as well as day-to-day use.

The control process used for M&TE should be a well established Recall Program containing as a minimum the following controls:

- Total inventory listing
- calibration DUE notices - weekly
- Individual automatic job opener and information cards
- calibration OVERDUE notices - weekly
- exception report for program errors
- scheduled and nonscheduled action history reporting

- p. Describe the actions taken for contaminated measuring and test equipment (M&TE). (K&S 1.8-1.i)

Equipment subject to radioactive contamination should be packaged and used in a manner that minimizes the possibility of external and internal contamination. This should be emphasized as part of the on-the-job training program of maintenance workers (see DOE 4330.4B paragraph 3). These practices can help minimize the spread of contamination and minimize the amount of M&TE kept only for use on contaminated systems and equipment. Consideration should be given to establishing an area for storing and calibrating contaminated M&TE.

- q. Discuss the guidelines for the evaluation of measuring and test equipment (M&TE). (K&S 1.8-1.j)

Results of M&TE calibrations should be trended, and corrective actions should be determined for any M&TE reliability problems. This predictive technique can identify needed corrections or changes to the M&TE program, such as adding or deleting M&TE devices, adjusting calibration frequencies, correcting procedures, or upgrading M&TE quality.

The M&TE program should be periodically reviewed to verify that it is supporting the safe and reliable operation of the facility. The review should include an assessment of M&TE availability.

Competency 1.9

Facility maintenance management (FAC# 1.30) personnel shall demonstrate a working level knowledge of modification work.

1. Supporting Knowledge and/or Skills
 - a. Describe the difference between temporary and permanent repairs/work.
 - b. Discuss the restrictions associated with temporary modifications.
 - c. Explain who can authorize temporary modifications.
 - d. Describe the process for temporary modifications.
 - e. Discuss the requirements and controls in place to prevent unapproved modifications.

2. Self-Study Information

Competency 1.9 addresses modification work. Competency 1.9 is at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Conduct of Operations Requirements For DOE Facilities, DOE Order 5480.19
- Guide to Good Practices for Control of Equipment and System Status, DOE-STD-1039-93
- Guide to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities, DOE-STD-1051-93
- Control of Temporary Modifications, Safety Notice 93-02 DOE/EH-0345
- Plant Modification Control Program, INPO 85-013 (TS-402)
- Temporary Modification Control, INPO 85-016 rev 2 of 4/92

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.9-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.6.4, page I-39; Section 8.3.5, pages II-50; and Sections 18.3.1 and 18.3.2, pages II-95 - II-96.
 - Conduct of Operations Requirements For DOE Facilities, (DOE Order 5480.19), Chapter VIII Section C.9, page I-51.
- b. For Supporting Knowledge and Skills **1.9-1.b** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Sections 18.3.1 and 18.3.2, pages II-95 - II-96.
 - Conduct of Operations Requirements for DOE Facilities (DOE Order 5480.19), Attachment I, Chapter VIII, Section C.9, page I-51.
 - Guide to Good Practices for Control of Equipment and System Status (DOE-STD-1039-93), Section 4.9, page 13.
 - Control of Temporary Modifications (Safety Notice 93-02 DOE/EH-0345), Hazard Mitigation, Section 1, pages 5 - 6.
- c. For Supporting Knowledge and Skills **1.9-1.c** refer to:
 - Control of Temporary Modifications (Safety Notice 93-02 DOE/EH-0345), Hazard Mitigation Section 2, page 6.
- d. For Supporting Knowledge and Skills **1.9-1.d** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Sections 18.1, page II-94.
 - Conduct of Operations Requirements for DOE Facilities (DOE Order 5480.19), Attachment I, Chapter VIII, Section C.9, page I-51.
 - Guide to Good Practices for Control of Equipment and System Status (DOE-STD-1039-93), Section 4.9, page 13.
 - Control of Temporary Modifications (Safety Notice 93-02 DOE/EH-0345), Hazard Mitigation, pages 5 - 6.
- e. For Supporting Knowledge and Skills **1.9-1.e** refer to:
 - Guide to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Section 4.3.4, pages 26 - 28.
 - Control of Temporary Modifications (Safety Notice 93-02 DOE/EH-0345), Hazard Mitigation Section 1, pages 5 - 6.

4. Practice Exercise

- a. Describe the difference between temporary and permanent repairs/work. (K&S 1.9.1.a)

- b. List five (5) examples of temporary modifications. (K&S 1.9-1.a)
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- c. Why should a safety review occur prior to implementation of temporary repairs or temporary modifications? (K&S 1.9-1.b)

- d. In addition to the safety reviews prior to the implementation of temporary modifications, what maintenance reviews should be conducted? (K&S 1.9-1.b)

- e. Control of Temporary Modifications (Safety Notice 93-02 DOE/EH-0345) recommends that responsibility for implementation of temporary modification be assigned to one individual or a dedicated team. Using a site specific reference, identify who can authorize temporary modifications. (K&S 1.9-1.c)

- f. Describe the process for temporary modifications. (K&S 1.9-1.d)

Chapter Modification Work

- g. What recommendations does Safety Notice 93-02 DOE/EH-0345, Hazard Mitigation Section 1, make regarding assigning overall responsibility of a modification package? (K&S 1.9-1.e)

- h. What recommendations does Safety Notice 93-02 DOE/EH-0345, Hazard Mitigation Section 1, make regarding drawings in a modification package? (K&S 1.9-1.e)

- i. List the recommendations that Safety Notice 93-02 DOE/EH-0345, Hazard Mitigation Section 1, recommends to minimize damage resulting from inadequate temporary modifications. (K&S 1.9-1.e)
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5. Practice Exercise Answers

- a. Describe the difference between temporary and permanent repairs/work. (K&S 1.9.1.a)
- Temporary repairs are temporary modifications to the facility that allow equipment to remain in or be returned to service in a condition that is not the same as the original design specification. Prior to implementation, temporary repairs should receive a safety review in accordance with the facility temporary modification program to ensure the adequacy of the repair and its effect on personnel and equipment safety and reliability. Temporary repairs should be tracked after their completion for consideration of permanent repairs. Permanent corrective action should be taken as soon as practicable.
- b. List five (5) examples of temporary modifications. (K&S 1.9-1.a)
- Any five of the following (or equivalents)
- electrical jumpers
 - lifted leads
 - pulled circuit boards
 - disabled annunciators or alarms
 - mechanical jumpers or bypasses
 - temporary setpoint changes
 - installed or removed blank flanges
 - disabled relief or safety valves
 - installed or removed filters or strainers
 - plugged floor drains
 - temporary pipe supports
- c. Why should a safety review occur prior to implementation of temporary repairs or temporary modifications? (K&S 1.9-1.b)
- To ensure adequacy of the repair and determine its effect on personnel safety, equipment safety, and reliability.
- d. In addition to the safety reviews prior to the implementation of temporary modifications, what maintenance reviews should be conducted? (K&S 1.9-1.b)
- All future maintenance activities should be identified and added to the preventive or predictive maintenance programs as applicable.
- e. Control of Temporary Modifications (Safety Notice 93-02 DOE/EH-0345) recommends that responsibility for implementation of temporary modification be assigned to one individual or a dedicated team. Using a site specific reference, identify who can authorize temporary modifications. (K&S 1.9-1.c)
- Site specific information, refer to site specific references.

- f. Describe the process for temporary modifications. (K&S 1.9-1.d)
Temporary modifications should be accomplished under the same basic administrative controls as those applied to facility maintenance activities so that there are no increases in risk to facility, equipment, environment, or personnel because of the modification work.
- g. What recommendations does Safety Notice 93-02 DOE/EH-0345, Hazard Mitigation Section 1, make regarding assigning overall responsibility of a modification package? (K&S 1.9-1.e)
Assign overall responsibility for modifications to one individual and an alternate to ensure continuity of thought and implementation.
- h. What recommendations does Safety Notice 93-02 DOE/EH-0345, Hazard Mitigation Section 1, make regarding drawings in a modification package? (K&S 1.9-1.e)
Use legible drawings and include all directions in modification packages rather than on drawings.
- i. List the recommendations that Safety Notice 93-02 DOE/EH-0345, Hazard Mitigation Section 1, recommends to minimize damage resulting from inadequate temporary modifications. (K&S 1.9-1.e)
- Require that all modifications, including significant temporary modifications, be prepared by a dedicated design organization.
 - Assign overall responsibility for modifications to one individual and an alternate to ensure continuity of thought and implementation.
 - Require independent technical and safety review of all modifications that include consideration of the integrated plant response to the modification and the synergistic effect of the modification.
 - Evaluate temporary modifications for unreviewed safety question determinations in accordance with the requirements of DOE Order 5480.21, Unreviewed Safety Questions.
 - Require a complete walkdown of proposed modifications as part of the modification development process.
 - Provide operators with instructions for operating temporarily modified equipment and guidance for periodic monitoring of operation through surveillance testing or calibration.
 - Use legible drawings and include all directions in modification packages rather than on drawings.
 - Require independent verification and sign-off for critical steps in work packages and procedures.
 - Provide specific criteria for quality control inspection points during implementation of modifications.

Chapter Modification Work

- Provide explicit actions to be followed and identify individuals to be notified if field conditions differ from anticipated conditions in modification packages.
 - Establish criteria for the maximum number of changes that can occur prior to requiring a complete work package revision.
 - Require thorough reviews of changes to approved packages in order to ascertain the full impact of change.
 - Evaluate tasks associated with the modification to ascertain if they can be accomplished within the time constraints identified.

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Competency 1.10

Facility maintenance management (FAC# 1.31) personnel shall demonstrate a working level knowledge of the requirements of post-maintenance testing.

1. Supporting Knowledge and/or Skills

- a. Discuss the importance of post-maintenance testing.
- b. Describe the elements of an effective post-maintenance testing program.
- c. Describe the scope, such as equipment, systems, or activities, of a post-maintenance testing program.
- d. Describe the control of a post-maintenance testing program.
- e. Discuss the requirements of test performance, documentation, and acceptance of post-maintenance testing.

2. Self-Study Information

Competency 1.10 addresses post-maintenance testing. Competency 1.10 is at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Conduct of Operations Requirements for DOE Facilities, DOE Order 5480.19
- Guideline To Good Practices For Post Maintenance Testing At DOE Nuclear Facilities, DOE-STD-1065-94
- Post-Maintenance Test Programs, Office of Nuclear and Facility Safety, Safety Notice 95-04 DOE/EH-0513
- Post-Maintenance Testing, INPO 87-028 Good Practice MA-305

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.10-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.4.7, page I-25 - I-26 and Chapter II, Sections 9.1 and 9.2, pages II-50 - II-51.
 - Guideline To Good Practices For Post Maintenance Testing At DOE Nuclear Facilities (DOE-STD-1065-94), Sections 1.1, 3.1.1 and 3.2.1, pages 1 and 6 - 7.
 - Post-Maintenance Test Programs (Office of Nuclear and Facility Safety, Safety Notice 95-04 DOE/EH-0513)
- b. For Supporting Knowledge and Skills **1.10-1.b** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.4.7, page I-25 - I-26 and Section 9.3.1, page II-51.
 - Guideline To Good Practices For Post Maintenance Testing At DOE Nuclear Facilities (DOE-STD-1065-94), Section 3.2.1, page 7.
 - Post-Maintenance Test Programs (Office of Nuclear and Facility Safety, Safety Notice 95-04 DOE/EH-0513).
- c. For Supporting Knowledge and Skills **1.10-1.c** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.4.7, page I-25 - I-26 and Section 9.3.2, pages II-52 - II-54.
 - Guideline To Good Practice For Post Maintenance Testing At DOE Nuclear Facilities (DOE-STD-1065-94), Section 3.4.1, pages 9 - 10.
 - Post-Maintenance Test Programs (Office of Nuclear and Facility Safety, Safety Notice 95-04 DOE/EH-0513).
- d. For Supporting Knowledge and Skills **1.10-1.d** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 9.3.3, pages II-54 - II-55.
 - Guideline To Good Practice For Post Maintenance Testing At DOE Nuclear Facilities (DOE-STD-1065-94), Section 3.4.2, pages 11 - 13.
 - Conduct of Operations Requirements for DOE Facilities (DOE Order 5480.19), Chapter VIII, Section 7, page I-50.
 - Post-Maintenance Test Programs (Office of Nuclear and Facility Safety, Safety Notice 95-04 DOE/EH-0513).

Chapter Post-Maintenance Testing

- e. For Supporting Knowledge and Skills **1.10-1.e** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.4.7, page I-25 - I-26 and Section 9.3.4, pages II-55 - II-56.
 - Guideline To Good Practice For Post Maintenance Testing At DOE Nuclear Facilities (DOE-STD-1065-94), Section 3.4.3, pages 13 - 14.
 - Post-Maintenance Test Programs (Office of Nuclear and Facility Safety, Safety Notice 95-04 DOE/EH-0513).

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Chapter Post-Maintenance Testing

- c. Describe the scope a post-maintenance testing program. (K&S 1.10-1.c)
- d. List the equipment, systems, or activities that a post-maintenance testing program should involve. (K&S 1.10-1.c)
- Post maintenance testing should be accomplished on equipment, systems, or activities such as the following:
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- e. Describe the conditions under which post-maintenance testing should occur. (K&S 1.10-1.c)

- f. Maintenance has been performed on an item that requires post maintenance testing, however facility conditions do not permit immediate testing of the item after maintenance. What action should be taken? (K&S 1.10-1.d)

- g. A component undergoing post maintenance testing fails. Describe the actions that should be taken. (K&S 1.10-1.e)

5. Practice Exercise Answers

- a. Discuss the importance of post-maintenance testing. (K&S 1.10-1.a)

Post maintenance testing is used to verify that the maintenance was performed correctly and that the equipment operates correctly and performs its desired function.

Post maintenance testing is performed to ensure that equipment performs its intended function when returned to service following maintenance, that the original deficiency is corrected, and that a new deficiency has not been created.

- b. Describe the elements of an effective post-maintenance testing program. (K&S 1.10-1.b)

A post maintenance testing program should include the following elements:

- Assigning responsibility for determining post maintenance test requirements using functional groups such as operations, maintenance, and technical support.
- Determining the scope of the post maintenance testing program to help ensure that appropriate levels of testing are applied to facility equipment and that redundant testing is minimized.
- Tracking the status of equipment that has undergone maintenance to ensure all testing is completed prior to work closeout.
- Conducting proper post maintenance tests (PMT), documenting the results, and verifying that the resulting data meet acceptance criteria.
- Guidance is available to planners for identifying appropriate tests.
- Testing is conducted under the appropriate system operating parameters.
- A form is used to authorize, document, and review the results of PMT.
- Post-test system restoration is formally controlled (restoring system to normal and/or standby modes following completion of PMT).

- c. Describe the scope a post-maintenance testing program. (K&S 1.10-1.c)

The scope of post-maintenance testing should be based on the extent of the preventive or corrective maintenance performed on the component.

- d. List the equipment, systems, or activities that a post-maintenance testing program should involve. (K&S 1.10-1.c)

Post maintenance testing should be accomplished on equipment, systems, or activities such as the following:

- maintenance that affects the integrity or operation of a liquid or gas system
- maintenance that affects mechanical strength of components or fittings
- equipment that is included in special programs such as the in-service inspection and environmental qualification programs
- maintenance that affects or removes design-approved radiation shielding
- electrical distribution equipment such as breakers, bus work, or high-voltage connections
- electrical control circuitry such as protection relays, limit switches, or permissive relays
- electronic components such as controllers, circuit cards, and transmitters
- instrumentation and instrumentation loops
- Health Physics and chemistry instrumentation
- Measuring and test equipment (M&TE)
- Temporary systems that have been installed as substitutes for normally operational systems or portions of systems

- e. Describe the conditions under which post-maintenance testing should occur. (K&S 1.10-1.c)

Test should be performed under conditions that represent normal operating conditions, such as flow, differential pressure, temperature, input signals values, and fluid types. In some cases testing should be performed under conditions that replicate emergency or abnormal conditions the component is expected to operate under.

Test should be conducted in accordance with the approved written post maintenance test or procedures. The documentation should provide measure performance and allow for the documentation and review of test data.

Chapter Post-Maintenance Testing

- f. Maintenance has been performed on an item that requires post maintenance testing, however facility conditions do not permit immediate testing of the item after maintenance. What action should be taken? (K&S 1.10-1.d)

The work request should be held open or some other tracking method should be used until the equipment can be tested.

Danger or caution tags may be required for the equipment until proper post maintenance testing can be completed.

Equipment should not be declared operable until the post maintenance testing has been satisfactorily completed.

- g. A component undergoing post maintenance testing fails. Describe the actions that should be taken. (K&S 1.10-1.e)

If the equipment cannot be repaired and satisfactorily tested in a short period of time (normally prior to the next shift change), the degraded or inoperable status of the equipment should be documented such that the operators understand the limitations of this equipment. Technical specifications should be consulted and appropriate actions should be taken until the equipment is properly tested and returned to service.

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Competency 1.11

Facility maintenance management (FAC# 1.32) personnel shall demonstrate a working level knowledge of the requirements for material receipt, inspection, handling, storage, retrieval, and issuance.

1. Supporting Knowledge and/or Skills

- a. Discuss the requirements for the receipt and inspection of parts, materials, and equipment.
- b. Discuss the requirements for establishing a procedure for items requiring special handling instructions.
- c. Discuss the requirements for storing material and equipment.
- d. Describe examples of items that should be observed and corrected during periodic general inspections of stores.
- e. Discuss the requirements for retrieving and issuing of parts, materials, or equipment.

2. Self-Study Information

Competency 1.11 addresses material receipt, inspection, handling, storage, retrieval, and issuance. Competency 1.11 is at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities, DOE-STD-1071-94

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.11-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.5.3, page I-31 - I-32 and Section 11.3.1, page II-60.
 - Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities (DOE-STD-1071-94), Section 3.4.1, pages 5 - 7.
- b. For Supporting Knowledge and Skills **1.11-1.b** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 11.3.2, pages II-61.
 - Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities (DOE-STD-1071-94), Section 3.4.2, pages 7 - 9.
- c. For Supporting Knowledge and Skills **1.11-1.c** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.5.3, page I-31 - I-32 and Section 11.3.3, pages II-61 - II-62.
 - Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities (DOE-STD-1071-94), Section 3.4.3, pages 9 - 12.
- d. For Supporting Knowledge and Skills **1.11-1.d** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 11.3.3, pages II-62.
 - Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities (DOE-STD-1071-94), Section 3.4.3, pages 10 - 12.
- e. For Supporting Knowledge and Skills **1.11-1.e** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.5.3, page I-31 - I-32 and Section 11.3.4, pages II-63 - II-64.
 - Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities (DOE-STD-1071-94), Section 3.4.4, pages 12 - 13.

4. Practice Exercise

- a. Who is responsible for the receipt and inspection of parts, materials, and equipment. (K&S 1.11-1.a)
 - 1) Maintenance personnel
 - 2) Quality Control
 - 3) Stores personnel
 - 4) Technical staff
- b. Why are parts, materials, and equipment inspected before they are accepted for storage or use. (K&S 1.11-1.a)
- c. How is the Technical Staff involved in the receipt and inspection of parts, materials, and equipment? (K&S 1.11-1.a)
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d. What information should be included in the procedures for items requiring special handling instructions? (K&S 1.11-1.b)

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e. Discuss the requirements for storing material and equipment. (K&S 1.11-1.c)

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- f. According to DOE Order 4330.4B, describe examples of items that should be observed and corrected during periodic general inspections of stores. (K&S 1.11-1.d)

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- g. Discuss the requirements for retrieving and issuing of parts, materials, or equipment. (K&S 1.11-1.e)

5. Practice Exercise Answers

- a. Who is responsible for the receipt and inspection of parts, materials, and equipment. (K&S 1.11-1.a)

1) Maintenance personnel

2) Quality Control

3) Stores personnel

4) Technical staff

- b. Why are parts, materials, and equipment inspected before they are accepted for storage or use. (K&S 1.11-1.a)

To ensure the parts, materials, and equipment:

- agree with the approved purchase documentation
- are packaged in accordance with purchase order specifications
- have necessary product control requirements furnished by the vendor
- appear to be in good condition.

- c. How is the Technical Staff involved in the receipt and inspection of parts, materials, and equipment? (K&S 1.11-1.a)

- May be needed to assist in the inspection of more complicated parts, materials, and equipment.
- Should approve any deviation from design specifications of material or equipment received before it is accepted into the stores system
- Should approve any upgrade of materials or equipment. An acceptance tag or label placed on the received material may be used to signify that the receiving inspection was satisfactory and that the applicable requirements have been met.

- d. What information should be included in the procedures for items requiring special handling instructions? (K&S 1.11-1.b)

Procedures should be developed for items requiring special handling instructions. The procedures should include information such as:

- weight
- size
- chemical reactivity
- radioactivity
- susceptibility to physical shock
- susceptibility to damage
- susceptibility to electrostatic sensitivity

- e. Discuss the requirements for storing material and equipment. (K&S 1.11-1.c)
- Material and equipment should be stored in a manner that provides:
 - maximum protection
 - ready availability for the intended use
 - due consideration for environmental conditions
 - the ability to provide necessary preventative maintenance as appropriate
 - controlled personnel access
 - A shelf life control program should be provided for stores items that are important to safe and reliable facility operation. Items with finite storage lifetimes should be tracked so that stock that has exceeded its shelf life is not issued.
 - Material and equipment should be stored by intended end use to prevent inadvertent use of the wrong category of item. If segregation is not practical, marking or tagging techniques should be developed to preclude use of the wrong material or equipment.
 - A method should be established to identify parts or materials that are designated for maintenance activities or modifications.
 - Items placed into or removed from stores should be promptly documented so that the stores inventory accurately reflects current status. The stores record system should also indicate the location of items in the warehouse, stores, issue room, or other designated storage areas.
 - Provisions should be made for "minimum\maximum" lists for parts, materials, and equipment and for prompt reordering when the minimum limit has been reached. These limits should reviewed periodically and adjusted based on usage, maintenance experience, cost, and leadtime.
- f. According to DOE Order 4330.4B, describe examples of items that should be observed and corrected during periodic general inspections of stores. (K&S 1.11-1.d)
- corrosive chemical not segregated and stored near equipment and metal stock
 - flammables not properly stored
 - radioactive material not properly controlled
 - stainless steel components not protected from direct contact with other metals, particularly carbon steel
 - relief valves, motors, and other equipment not stored on their bases
 - containers, boxes, barrels stacked to unreasonable heights and not in accordance with vendor instructions
 - parts, materials, and equipment not repackaged or protective caps not reinstalled to seal items on which previous packing or protective caps have deteriorated, been damaged, or been lost while in storage
 - elastometers and polypropylene parts stored in areas exposed to light
 - machined surfaces not protected
 - equipment internals not protected from intrusion of foreign materials
 - proper rodent control not established to protect material and equipment

- g. Discuss the requirements for retrieving and issuing of parts, materials, or equipment. (K&S 1.11-1.e)
- Parts, materials, and equipment removed from storage should receive the same care they received when handled for storage. A method should be established to control parts, materials, and equipment after issue to ensure use in the correct application and to maintain the necessary traceability.
 - All receipt documents and inspections should be satisfactorily completed before an item is issued. For items such as environmentally qualified spare materials and parts, proper documentation should be maintained to ensure traceability.
 - A catalog for parts, materials, and equipment should be developed allowing facility personnel to determine what is available for issue. The catalog could assist in more efficient planning and execution of maintenance activities. The catalog should provide a cross-reference listing that provides such information as:
 - manufacturer part number
 - facility part number
 - noun name
 - component or system for which the part is used

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Competency 1.12

Facility maintenance management (FAC# 1.33) personnel shall demonstrate a working level knowledge of the requirements of maintenance tools and equipment control.

1. Supporting Knowledge and/or Skills

- a. Discuss the criteria of a program for the development of new or special tools and equipment.
- b. Discuss the guidelines for storing and issuing maintenance tools and equipment.
- c. Discuss the guidelines for tool and equipment maintenance.

2. Self-Study Information

Competency 1.12 addresses maintenance tools and equipment control. Competency 1.12 is at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Guideline to Good Practices for Maintenance Facilities, Equipment, and Tools at DOE Nuclear Facilities, DOE-STD-1067-94
- Guideline to Good Practices for Maintenance Tools and Equipment Control at DOE Nuclear Facilities, DOE-STD-1069-94

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.12-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 4.2, page II-15 and Section 13.2, page II-70.
 - Guideline To Good Practices For Maintenance Facilities, Equipment and Tools At DOE Nuclear Facilities (DOE-STD-1067-94), Section 3.4.2.b, page 13.

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- b. For Supporting Knowledge and Skills **1.12-1.b** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.5.5, page I-34 - I-35; Section 4.3.2, page II-18; and Section 13.3.1, page II-71.
 - Guideline To Good Practices For Maintenance Facilities, Equipment and Tools At DOE Nuclear Facilities (DOE-STD-1067-94), Section 3.4.2.a, page 12.
 - Guideline to Good Practices for Maintenance Tools and Equipment Control at DOE Nuclear Facilities, (DOE-STD-1069-94), Section 3.4.1, pages 7 - 10.
- c. For Supporting Knowledge and Skills **1.12-1.c** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.5.5, page I-34 - I-35; Section 4.3.2, page II-18; and Section 13.3.2, pages II-71 - II-72.
 - Guideline to Good Practices for Maintenance Tools and Equipment Control at DOE Nuclear Facilities, (DOE-STD-1069-94), Section 3.4.2, page 10.

4. Practice Exercise

- a. Discuss the criteria of a program for the development of new or special tools and equipment. (K&S 1.12-1.a)

- b. Discuss the guidelines for storing and issuing maintenance tools and equipment. (K&S 1.12-1.b)

- c. Why are some tools included in the preventive maintenance program? (K&S 1.12-1.c)

5. Practice Exercise Answers

- a. Discuss the criteria of a program for the development of new or special tools and equipment. (K&S 1.12-1.a)

A program for the development of new or special tools and equipment should specify formal criteria covering:

- safety
- identification
- availability for future use
- cost-effectiveness

Supervisors should have an active role in identifying and approving tool and equipment improvements that make maintenance more effective and efficient. These improvements can result in improved safety for personnel and equipment, improved work quality, and improved facility reliability.

The process of providing and developing tools and equipment should include considerations of cost, control, and storage. Maintenance supervisors should review proposed designs for special tool and equipment to determine cost justification, effectiveness, safety considerations, and the need for reviews by other organizations.

The development of new or special tools should not be so strict that employee innovation is discouraged.

Special tools, test rigs, special equipment, lifting and rigging equipment, and mockups should be suitable for their intended use and properly identified.

Instructions should be provided for the use of special tools and equipment for high hazard or high stress tasks.

Special tools and equipment may require special storage and control and should be handled in accordance with identified requirements.

Chapter Tools and Equipment Control

- b. Discuss the guidelines for storing and issuing maintenance tools and equipment. (K&S 1.12-1.b)

Responsibility should be assigned for the proper storage and issuance of both stationary and portable tools and equipment.

Permanent issuance of tools to individuals or groups of craft personnel who use the tools on a day-to-day basis and who are responsible for maintaining the contributes to worker efficiency.

Other tools and equipment should be available on an as-needed basis. These tools should be stored in a centrally located facility readily accessible to the shops and normal work areas. The tools should be readily accessible to craft personnel.

The tools should be controlled with sign-out sheets and tool crib attendants. This is to provide accountability and availability of the tools.

- c. Why are some tools included in the preventive maintenance program? (K&S 1.12-1.c)

Proper preventive maintenance can result in improved personnel safety and extend the life of tools and equipment. Inclusion also enhances the availability and reliability of equipment and tools.

Competency 1.13

Facility maintenance management (FAC# 1.34) personnel shall demonstrate a working level knowledge of the requirements for facility condition inspections.

1. Supporting Knowledge and/or Skills

- a. Explain the purpose of a Facility Condition and Housekeeping Program.
- b. Discuss the elements of an effective inspection program.
- c. Describe indicators of good facility conditions and housekeeping standards.
- d. Discuss the elements of an effective procedure addressing facility condition inspections.
- e. Describe the importance of training personnel in inspection techniques.
- f. Describe the elements of routine inspections.
- g. Discuss the requirements for reporting deficiencies and deficiency follow-up.

2. Self-Study Information

Competency 1.13 addresses facility condition inspections. Competency 1.13 is at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities, DOE-STD-1072-94
- Plant Material Deficiency Identification, INPO 83-045 (MA-301)
- Plant Inspection Program, INPO 87-023 (MA-312)

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.13-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 14.1, pages II-72 - II-73.
 - Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities (DOE-STD-1072-94), Section 1.1, pages 1 - 2.
- b. For Supporting Knowledge and Skills **1.13-1.b** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 14.2, pages II-73 - II-74.
 - Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities (DOE-STD-1072-94), Section 3.1, pages 5 - 6.
- c. For Supporting Knowledge and Skills **1.13-1.c** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.2.1, page I-14 - I-15 and Section 14.3.1, pages II-74 - II-76.
- d. For Supporting Knowledge and Skills **1.13-1.d** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 14.3.3, pages II-76.
- e. For Supporting Knowledge and Skills **1.13-1.e** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 14.3.2 and 14.3.4, pages II-76 - II-77.
- f. For Supporting Knowledge and Skills **1.13-1.f** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 14.3.5, pages II-77.
 - Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities (DOE-STD-1072-94), Section 3.4.1 - 3.4.5, pages 8 - 10.
- g. For Supporting Knowledge and Skills **1.13-1.g** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 14.3.6 - 14.3.7, pages II-78 - II-79.
 - Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities (DOE-STD-1072-94), Section 3.4.6 - 3.5.4, pages 11 - 14.

4. Practice Exercise

- a. Explain the purpose of a Facility Condition and Housekeeping Program. (K&S 1.13-1.a)

- b. Discuss the elements of an effective inspection program. (K&S 1.13-1.b)

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- c. Describe indicators of good facility conditions and housekeeping standards. (K&S 1.13-1.c)

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- d. Discuss the elements of an effective procedure addressing facility condition inspections. (K&S 1.13-1.d)
- Administrative procedures that describe the inspection program should define:
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- e. What is the benefit of having key individuals accompany the managers and supervisors during their inspections? (K&S 1.13-1.e)
- f. Once a deficiency is identified by an inspector, in addition to recording the deficiency what should the inspector investigate? (K&S 1.13-1.e)
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- g. Describe the elements of routine inspections. (K&S 1.13-1.f)
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- h. Concerning the reporting of deficiencies: (K&S 1.13-1.g)
 - 1. How should deficiencies normally be reported?

 - 2. How should significant facility condition and safety deficiencies be reported?

- i. In addition identifying, reporting, and correcting deficiencies, what actions should be taken? (K&S 1.13-1.g)

5. Practice Exercise Answers

- a. Explain the purpose of a Facility Condition and Housekeeping Program. (K&S 1.13-1.a)

The involvement of facility managers and supervisors in periodic facility walkdowns and inspections clearly displays management standards to all personnel and can significantly improve the condition of the facility. A program for identification and dispositioning of facility condition deficiencies and housekeeping discrepancies is an important step in maintaining facilities and equipment in a condition of maximum safety reliability and availability.

The appearance and proper functioning of facility systems and equipment are key indicators of a well-maintained and operated facility. Good facility condition, cleanliness, and housekeeping can be established and maintained by knowledgeable individuals who are alert to deficiencies when they are in the facility and take prompt corrective action. Additionally, there needs to be a periodic focused inspection effort to assist in effective identification and correction of facility deficiencies.

Maintaining system and equipment within design conditions results in benefits such as minimizing fluid leakage, minimizing control room alarms caused by malfunctioning equipment, and maintaining equipment environmental integrity. Another benefit of good facility condition and housekeeping is easier access for operations and maintenance by reducing sources and spread of radioactive contamination.

- b. Discuss the elements of an effective inspection program. (K&S 1.13-1.b)

The following elements should be included in the inspection program:

- Facility managers should set high facility condition and house keeping standards and communicate them to all personnel to provide a clear understanding of these standards.
- Appropriate personnel should receive inspection techniques training.
- Facility managers and supervisors should personally participate in inspections.
- Inspection areas should be assigned such that the entire facility is periodically inspected, including areas with difficult access (e.g., high radiation areas and locked areas).
- An inspection coordinator should be assigned to implement, schedule, and monitor the effectiveness of the inspection program.
- Identified deficiencies should be reported and corrected in a timely manner so that personnel can see the positive results of the inspection program.
- Instructions could be prepared to establish the program and define responsibilities for conducting inspections, correcting deficiencies, and accomplishing other tasks associated with the program, such as on-the-spot correction of minor deficiencies.

The instructions should clearly define:

- what is considered a minor deficiency
 - who is allowed to correct them
 - the limitations and documentation associated with the deficiency.
 - Inspection guidelines and criteria could be prepared to assist the assigned inspectors in performing their inspections.
- c. Describe indicators of good facility conditions and housekeeping standards. (K&S 1.13-1.c)
- Setting standards involves establishing an atmosphere of proper work ethics, positive attitudes, and specific expectations by management that are realistic, within the capabilities of the staff, and that are consistent with sound engineering judgement and good economic practice. Standards must be communicated effectively to all personnel so that they are clearly understood. Adherence to these standards should be accessed by facility managers and supervisors through the conduct of routine inspections. Some indicators of good facility condition and housekeeping standards are as follows:
- Rotating equipment is operating in accordance with design specifications.
 - Equipment is properly serviced.
 - Fluid system integrity is maintained.
 - Temporary repairs are recorded and controlled by the facility temporary modification program.
 - Instruments and gauges are operational, calibrated, on scale, and indicating values representative of the existing system and equipment conditions.
 - Energized electrical equipment and electronic equipment is operable, supplied from normal power sources, and protected from adverse environmental effects such as leaks and overheating.
 - Protective cabinet doors and electrical enclosure covers are installed to maintain design integrity.
 - Equipment and systems are insulated to control heat transfer to or from the environment, to control ambient noise levels, and to promote personnel safety.
 - Facility equipment and systems subject to corrosion are protected with a preservative to minimize corrosion.
 - Temporary environmental protection is provided, where appropriate.
 - Industrial safety and radiological hazards are minimized.
 - Walkway and equipment access is maintained.
 - Equipment is clean.
 - Facility areas, rooms, and grounds are maintained in a clean and orderly condition, including the storage of tools and materials.
 - Coatings or covering used to seal walls and floors in potentially contaminated areas are in good condition and assist in controlling contamination.
 - Unauthorized modifications or changes to the facility do not exist.
 - Illumination of areas, rooms, and grounds is maintained in a manner that provides sufficient light to perform inspections and minor maintenance.

- d. Discuss the elements of an effective procedure addressing facility condition inspections. (K&S 1.13-1.d)

Administrative procedures that describe the inspection program should define:

- expected standards
- provide for documentation of deficiencies
- provide for a means to follow up on deficiency corrective actions
- assign responsibilities for program implementation
- establish a means to measure program effectiveness.

Facility inspection implementing procedures could be incorporated into preventive maintenance or surveillance programs in a manner similar to other visual inspections such as housekeeping inspections. Deficiencies identified during the inspection should be documented by the inspector. Checklists of equipment to be inspected and types of problems to look for could be useful as guides for inspectors.

- e. What is the benefit of having key individuals accompany the managers and supervisors during their inspections? (K&S 1.13-1.e)

Discussions during the inspection should improve inspection techniques and convey the expected standards for facility condition and housekeeping.

- f. Once a deficiency is identified by an inspector, in addition to recording the deficiency what should the inspector investigate? (K&S 1.13-1.e)

The inspector should look closer and attempt to determine:

- the source or cause
- how long it has existed
- if the deficiency has been previously identified.

- g. Describe the elements of routine inspections. (K&S 1.13-1.f)

Routine inspections should include the following elements:

- Limit the size of inspection areas so that they are small enough to be thoroughly inspected in the time allotted.
- Schedule each facility area for periodic inspection.
- Periodically rotate inspectors through the various inspection areas.

- h. Concerning the reporting of deficiencies: (K&S 1.13-1.g)
 - 1. How should deficiencies normally be reported?
The inspector should report the results of each inspection to the inspection coordinator.
 - 2. How should significant facility condition and safety deficiencies be reported?
deficiencies observed should be immediately reported to the shift supervisor for appropriate near-term attention.
- i. In addition identifying, reporting, and correcting deficiencies, what follow-up actions should be taken? (K&S 1.13-1.g)
Reported deficiencies should be monitored to identify recurring, generic, and long-term problems. Actions taken to resolve these problems should include a failure or root-cause analysis and not merely a correction of symptoms. DOE 4330.4B paragraph 17, Analysis of Maintenance Problems, addresses the analysis of maintenance problems.

Competency 1.14

Facility maintenance management (FAC# 1.35) personnel shall demonstrate a working level knowledge of the requirements for management involvement.

1. Supporting Knowledge and/or Skills

- a. Discuss the importance of management's involvement in maintenance.
- b. Discuss the role and responsibilities of maintenance managers.
- c. Discuss the guidelines for management involvement, objective results, and feedback in relation to a maintenance program.
- d. Discuss the elements of a maintenance program evaluation.

2. Self-Study Information

Competency 1.14 addresses management involvement in the management of maintenance. Competency 1.14 is at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities, DOE-STD-1055-93
- Maintenance Management Topical Area Self Study Guide, SR-TA-MNT-SSG-01

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.14-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 15.2, pages II-79 - II-80.
 - Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities (DOE-STD-1055-93), Section 2.1, pages 3 - 4.

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- b. For Supporting Knowledge and Skills **1.14-1.b** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Sections 15.2 and 15.3.1, pages II-79 - II-80.
 - Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities (DOE-STD-1055-93), Sections 2.1 and 2.2.1, pages 3 - 5.
- c. For Supporting Knowledge and Skills **1.14-1.c** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.7.4, page I-43 - I-44; Section 2.3.4, pages II-7 - II-8; and Sections 15.3.2 - 15.3.3, pages II-80 - II-81.
 - Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities (DOE-STD-1055-93), Section 2.1, pages 3 - 4.
 - Maintenance Management Topical Area Self Study Guide, (SR-TA-MNT-SSG-01) Competency 1.2.
- d. For Supporting Knowledge and Skills **1.14-1.d** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.7.2, page I-41 - I-42 and Section 15.3.4, pages II-81 - II-82.
 - Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities (DOE-STD-1055-93), Section 2.2.5, pages 10 - 11.

4. Practice Exercise

- a. Discuss the importance of management's involvement in maintenance. (K&S 1.14-1.a)
- b. Discuss the role and responsibilities of maintenance managers. (K&S 1.14-1.b)

- c. Identify examples of work practices that should be reviewed and verified by maintenance managers. (K&S 1.14-1.b)

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Chapter Management Involvement

- d. What is the purpose of frequent non-scheduled individual tours of work areas both on- and off-shift by management? (K&S 1.14-1.b)

Tours provides:

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- e. In addition to first-hand observations, what other information can maintenance managers use to determine the status of maintenance operations and facilities? (K&S 1.14-1.b)

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Chapter Management Involvement

- f. Discuss the guidelines for management involvement to a maintenance program. (K&S 1.14-1.c)

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- g. Discuss the guidelines for objective results in relation to a maintenance program. (K&S 1.14-1.c)

- h. Discuss the guidelines for feedback in relation to a maintenance program. (K&S 1.14-1.c)

- i. Discuss the elements of a maintenance program evaluation. (K&S 1.14-1.d)

5. Practice Exercise Answers

- a. Discuss the importance of management's involvement in maintenance. (K&S 1.14-1.a)

Direct observation and immediate feedback by managers, especially managers several levels above first-line supervisors, may bolster the craft person's pride in his/her work. This can result in fewer errors, higher standards, and improved morale.

Managers should motivate first-line maintenance supervisors to observe the activities of craft personnel in the field by setting an example.

Frequent tours of the facility assists the maintenance managers become involved and understand the activities taking place in the facilities.

- b. Discuss the role and responsibilities of maintenance managers. (K&S 1.14-1.b)

Managers should be sufficiently involved with facility operations to be technically informed and personally familiar with the conditions at the operating facility to ensure the safety of DOE nuclear facility operations.

Managers should visit the facility, including visits at irregular hours, assess selected activities and portions of the facility, and leave a written record of their observations.

Managers should periodically review the maintenance program to verify that they are effectively accomplishing the intended objectives and the programs are upgraded as needed

- c. Identify examples of work practices that should be reviewed and verified by maintenance managers. (K&S 1.14-1.b)
- safety is the first priority for all work, ensure unsafe conditions and deficiencies are clearly identified
 - industrial safety and radiological protection practices
 - exposure of personnel to hazardous materials and conditions is minimized
 - the potential for the spread of radioactive or other hazardous materials is minimized through proper containment and handling
 - proper use of pre-job briefings and applicable training
 - quality of workmanship, materials, and parts
 - work being performed on the correct structures, systems, and components (SSC)
 - applicable authorization, procedures, documents, permits are available at the job site
 - individuals performing work or responsible for work are adequately trained and have a clear understanding of work scope and the effect of the work being performed
 - the purpose and importance of plant structures, systems, and components (SSC)
 - general facility layout (including emergency egress routes and assembly locations)
 - maintenance activities are under the control of the applicable owner/operator
 - maintenance personnel exhibit an attitude of first-effort quality workmanship
 - the concept of ALARA includes "value-added" considerations when planning work to minimize potential exposure
 - maintenance personnel are:
 - attentive to identifying deficiencies and off-normal conditions and bringing them to the attention of applicable managers
 - responsive to priority correction of deficiencies and off-normal conditions when approved by applicable managers
 - environmental protection/regulations
 - proper handling and storage of hazardous materials and waste minimization
 - procedure use, including adherence to step-by-step requirements, sign-offs, and work hold points
 - open system and component protection (foreign material exclusion)
 - accountability of tools, chemicals, and materials
 - use of proper tools for the proper job
 - work progress and time required to perform the job, especially in a Limiting Condition for Operation exists
 - operations and support organizations involvement is coordinated into applicable activities
 - effective trouble shooting techniques

Chapter Management Involvement

- by-passing or deactivation of safety controls, interlocks, and structures, systems, and components (SSC) for test purposes, calibration/certification, or maintenance is performed in accordance with detailed, approved procedures and permits
 - the requirements and conditions for restoring structures, systems, and components (SSC) to service following deactivation or by-passing is documented and verified
 - post maintenance testing instructions should be clearly defined, understood, and include the following:
 - clearly written instructions
 - specific parameter acceptance criteria
 - applicable test precautions and safety considerations
 - a test scope adequate to verify the adequacy of completed work
 - documentation of test results/data
 - test results review and written acceptance by operations
 - proper use of post-job reporting and when applicable post-job critiques
 - backlog is effectively managed
- d. What is the purpose of frequent non-scheduled individual tours of work areas both on- and off-shift by management? (K&S 1.14-1.b)

Tours provides:

 - first-hand observation of actual conditions
 - an opportunity to communicate expected performance standards through appropriate and timely recognition/feedback directly to individuals regarding either positive or negative observations
 - an opportunity to seek involvement in and to established ownership of approved actions at the level closest to and directly involved in performance improvement
 - incentive for individuals at all levels to take pride in their accomplishments
 - motivation for first-line supervisors and craftspersons to accept responsibility for the early detection of opportunities for improvement
 - the means for timely escalation of significant problems/concerns to the level of management having resolution authority

- e. In addition to first-hand observations, what other information can maintenance managers use to determine the status of maintenance operations and facilities? (K&S 1.14-1.b)
- key performance indicator trend reviews
 - critical self-assessments
 - exception reports
 - problem and corrective action status tracking
 - Lessons Learned and Alert System reviews
 - daily and weekly review of staff activities
 - customer feedback
 - craftsperson input
 - historical data
 - regulatory Environment, Safety, and Health (ESH) requirements
- f. Discuss the guidelines for management involvement to a maintenance program. (K&S 1.14-1.c)
- Managers should include time in their routine schedules for walking through the facility. This time should be directed at improving face-to-face communications and feedback at all levels of the maintenance organization.
 - Maintenance management should establish the percentage of time that first line supervisors are expected to spend supervising field work. The workload should be monitored and adjusted to allow first-line supervisors sufficient time to spend monitoring work in the field.
 - Facility tours and personnel contacts should also be planned for irregular hours (selected weekend and backshift) and cover selected facility areas and personnel activities.
 - The results and observations of these tours should be documented and reviewed for action.
 - Additional guidance and techniques for conducting facility inspections can be found in DOE 4330.4B paragraph Facility Condition Inspection.

- g. Discuss the guidelines for objective results in relation to a maintenance program. (K&S 1.14-1.c)

The results of maintenance performance indicators, goals and objectives, and other related information should be developed, trended, and reported to provide feedback. DOE 4330.4B paragraph 2, Maintenance Organization and Administration, provides information on the development of performance indicators, goals, and objectives for maintenance.

Reports should include:

- Trends of performance indicators, goals, and objectives
- a brief explanation for trends that appear unusual (positively or negatively)
- intended corrective measures where warranted.

- h. Discuss the guidelines for feedback in relation to a maintenance program. (K&S 1.14-1.c)

A key element of management involvement is the establishment of a feedback system where feedback and communication are continuously encouraged. This system should include planners, engineers, craft personnel, warehouse personnel, and others so that participation in improvements is promoted at all levels of the maintenance organization. Project teams should also include representatives from the affected crafts.

The ability to apply lessons learned from in-house maintenance experiences (and the experiences of others) is essential for long term success. Management should use information about problems encountered during maintenance activities to improve performance. Maintenance can also benefit by taking advantage of related experience at other facilities.

The maintenance manager, and sometimes the facility manager, may address specific groups on topics related to team integration, productivity, and motivation. Additionally, managers should set aside time for maintenance personnel to discuss problem areas and suggested improvements.

- i. Discuss the elements of a maintenance program evaluation. (K&S 1.14-1.d)
- Inspections, audits, reviews, investigations, and self-assessments are necessary for an effective maintenance program. Senior managers should periodically review and assess elements of the maintenance program. These assessments can assist line managers and supervisors in identifying and correcting program deficiencies. An evaluation of each maintenance element should be conducted at least every other year and should include inputs from managers and supervisors from maintenance and other groups such as operations, technical staff, and appropriate corporate departments. The evaluation should address overall effectiveness of the program element. It should address interorganizational and intraorganizational coordination problems that create work delays and reduce productivity. Areas needing improvement should be assigned for corrective action and follow-up.

Examples of elements to be considered in this evaluation include:

- facility equipment and systems, and the ability of craft personnel to perform high quality maintenance
- maintenance training
- procurement activities
- Measuring and Test Equipment (M&TE)

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Competency 1.15

Facility maintenance management (FAC# 1.36) personnel shall demonstrate a working level knowledge of the requirements of maintenance history.

1. Supporting Knowledge and/or Skills
 - a. Discuss the importance of maintaining a maintenance history.
 - b. Describe the guidelines for the following elements of a maintenance history program development:
 - Equipment identification
 - Data identification
 - c. Describe the guidelines for data collection.
 - d. Discuss common uses of a maintenance history.
 - e. Describe configuration control and its relationship to the maintenance work control process and the maintenance history file.
2. Self-Study Information

Competency 1.15 addresses maintenance history. Competency 1.15 is at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities, DOE-STD-1051-93
- Guideline To Good Practices For Maintenance History At DOE Nuclear Facilities, DOE-STD-1068-94
- Guide for Operational Configuration Management Program, DOE-STD-1073-93-Pts. 1 and 2
- Maintenance History Program, INPO 86-002 MA-310

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.15-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.4.9, page I-27 - I-28 and Sections 16.1 and 16.2, pages II-84 - II-85.
 - Guideline To Good Practices For Maintenance History At DOE Nuclear Facilities (DOE-STD-1068-94), Section 3.1, page 4.
- b. For Supporting Knowledge and Skills **1.15-1.b** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Sections 16.3.1.a and 16.3.1.b, pages II-85 - II-86.
 - Guideline To Good Practices For Maintenance History At DOE Nuclear Facilities (DOE-STD-1068-94), Section 3.4.1, pages 5 - 7.
- c. For Supporting Knowledge and Skills **1.15-1.c** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 16.3.2, page II-86.
 - Guideline To Good Practices For Maintenance History At DOE Nuclear Facilities (DOE-STD-1068-94), Section 3.4.1.2, page 6.
- d. For Supporting Knowledge and Skills **1.15-1.d** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.4.9, page I-27 - I-28 and Section 16.3.3, pages II-86 - II-87.
 - Guideline To Good Practices For Maintenance History At DOE Nuclear Facilities (DOE-STD-1068-94), Section 3.4.2, pages 7 - 8.
- e. For Supporting Knowledge and Skills **1.15-1.e** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 8.2, page II-46; Section 16.2, page II-84 - II-85 and Section 18.3.1, page II-95.
 - Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Section 4.3.4, pages 26 - 28.
 - Guide for Operational Configuration Management Program (DOE-STD-1073-93-Pt.1), Section 1.2, pages I-4 - I-5 and Appendix I-A, pages I-A-2 - I-A-3.

4. Practice Exercise

- [illegible]

- c. Describe the guidelines for data identification of a maintenance history program development: (K&S 1.15-1.b)

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The specific data to be collected should include:

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- d. Describe the guidelines for data collection. (K&S 1.15-1.c)

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e. Discuss common uses of a maintenance history. (K&S 1.15-1.d)

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- f. Describe the relationship between configuration control and maintenance work control process and the maintenance history file. (K&S 1.15-1.e)

5. Practice Exercise Answers

- a. Discuss the importance of maintaining a maintenance history. (K&S 1.15-1.a)

Maintenance history and trending program should be maintained to document data, provide historical information for maintenance planning, and support maintenance and performance trending of facility systems and components.

Maintenance history programs can be used to improve:

- the balance of corrective and preventive maintenance (DOE 4330.4B paragraph 5)
- the planning, scheduling, and coordination of maintenance (DOE 4330.4B paragraph 7)
- the analysis of maintenance problems (DOE 4330.4B paragraph 17).

Maintenance history file can be used by plant management to identify trends that indicate a need for corrective action and by work planners as a reference to assist in the work planning process.

- b. Describe the guidelines for equipment identification of a maintenance history program development: (K&S 1.15-1.b)

Maintenance history program should clearly define the systems and equipment that require documentation and retention of historical data. Systems and components that affect safe and reliable facility operation should be documented. Equipment requiring repetitive maintenance should also be included in this program.

- equipment unique identification number and name
- system, manufacturer, model, serial number, and other appropriate name plate data
- lubrication data
- applicable vendor manuals and drawings
- spare parts reference numbers
- common equipment cross-references

The master equipment list (DOE 4330.4B paragraph 5) could be used effectively to establish this information.

- c. Describe the guidelines for data identification of a maintenance history program development: (K&S 1.15-1.b)

The maintenance history program should define the type of data that should be collected and recorded to effectively support the use of the program. Some examples of the data that should be included or cross referenced in the program are:

- corrective maintenance records
- preventive maintenance records
- modification packages
- vendor repair information
- startup test and other baseline data
- surveillance test data
- calibration data
- applicable industry experience information

The specific data to be collected should include:

- details of the work performed
- special equipment and tools used
- procedures and drawings needed
- spare parts installed
- personnel safety and radiation protection requirements
- post maintenance testing
- information that maybe useful at a later date.

- d. Describe the guidelines for data collection. (K&S 1.15-1.c)

Maintenance history file should be established by the maintenance manager responsible for the listed equipment. Typically components are grouped by system; however components can be grouped by component types. All information should be easily retrievable by shop supervisors, work planners, and the engineering support group.

The maintenance history file should contain the following information:

- Component Identification
- Component Description
- Maintenance Record
- Diagnostic Monitoring Data
- Vendor Correspondence
- provision for engineering review and analysis

- e. Discuss common uses of a maintenance history. (K&S 1.15-1.d)
- Failure analysis (provides some of the data needed to support analyzing and trending failures)
 - conduct of maintenance assessments (provides an input to identify rework for the purpose of identifying maintenance program improvements)
 - preventive maintenance (provides some of the data useful for identifying and justifying preventive maintenance program changes)
 - outages planning (provides some of the data useful for post outage evaluation and as a basis for planning the next outage)
 - post maintenance test planning
 - ALARA program (provides work time data useful for radiological exposure evaluation and planning)
 - budget preparation (provides an input for determining future maintenance needs based on experience and a justification for these expenditures)
 - review of DOE and industry experience, vendor information, and other documents to assess plant specific applicability
 - conduct of maintenance assessment (provides an input to identifying maintenance program improvements)
 - facility life extension (provides some of the data needed to support extension of plant design life)
 - contributes greatly to avoiding and understanding failures (DOE 4330.4B paragraph 17).
 - engineering reviews to determine abnormal trends and initiate corrective actions
 - work planner review to determine similar deficiencies or performance trends when preparing work order repair instructions
- f. Describe the relationship between configuration control and maintenance work control process and the maintenance history file. (K&S 1.15-1.e)
- Guide for Operational Configuration Management Program (DOE-STD-1073-93-Pt.1), cites DOE 4330.4A. The Maintenance Management Program establishes DOE expectations regarding the conduct of maintenance activities on various equipment, including repairable or replaceable equipment and non-replaceable facility life-limiting equipment, at both DOE nuclear and non-nuclear facilities. The maintenance activities are designed to provide assurance that the physical configuration is maintained within its design requirements. DOE 4330.4B includes DOE policy that directly relates to material condition and aging management: "Structures, systems, and components that are important to safe operation shall be subject to a maintenance program in order to meet or exceed their design requirements throughout their life." (DOE Order 4330.4B Section 7.b, page 3)

Chapter Maintenance History

DOE 4330.4B does not provide technical guidance on how the measurement are to be established or how degradation is to be forecasted. Configuration Management (CM) program has an adjunct program, Material Condition and Aging (MCA) Management, that develops analytical methods and testing techniques that can be used to meet the requirements of the maintenance program.

The Configuration Management (CM) program also interfaces with the Maintenance Management program through the change control and document control elements, which address the control of hardware and procedure changes. Within the maintenance program, the main interface is with the work control process (§ 3.4 page I-17 and § 8.3 page II-46), which manages and sequences maintenance activities in the field. Another important interface exists between preventive and predictive maintenance activities and the performance monitoring function of the assessment element of the Configuration Management program.

Competency 1.16

Electrical systems (FAC# 4.11), Instrumentation and control (FAC# 4.12), and Mechanical systems (FAC# 4.11) personnel shall demonstrate a familiarity level knowledge of Department of Energy (DOE) maintenance management requirements as defined in DOE Order 4330.4B, Maintenance Management Program.

1. Supporting Knowledge and/or Skills
 - a. Explain the Department's role in the oversight of contractor maintenance operations.
 - b. Identify the key elements of a contractor maintenance plan as required by DOE Order 4330.4B, Maintenance Management Program.
 - c. Describe configuration control and its relationship to the maintenance work control process and the maintenance history file.
 - d. Describe the mechanisms for feedback of relevant information, such as trend analysis and instrumentation performance/reliability data, to identify necessary program modifications.
 - e. Review a contractor preventive maintenance activity and describe the preventive maintenance factors to be considered as the activity is planned.
 - f. Discuss the importance of post-maintenance testing and the elements of an effective post-maintenance testing program.
 - g. Review the results of post-maintenance testing activities and discuss the acceptance of post-maintenance testing.
 - h. Discuss the importance of maintaining a maintenance history.
 - i. Review a maintenance history file and discuss the potential implications of repeat maintenance items.
 - j. Explain the intent of a Maintenance Problem Analysis Program and discuss a maintenance problem where this program has been employed.

Competency 1.17

Facility maintenance management (FAC# 2.1) personnel shall demonstrate a working level knowledge of the Department of Energy's requirements for facility maintenance management as outlined in DOE Order 4330.4B, Maintenance Management Program.

1. Supporting Knowledge and/or Skills

- a. Explain the Department of Energy's role in the oversight of contractor maintenance operations.
- b. Explain the intent of DOE Order 4330.4B, Maintenance Management Program.
- c. Discuss the Department's policy and objectives for maintenance management.
- d. Describe responsibilities and authorities for maintenance management programs.
- e. Describe the purpose, scope and requirements of Maintenance Implementation Plans (MIPs).
- f. Describe the provisions to allow nuclear facility program elements to include non-nuclear equipment.
- g. Discuss the requirements for the control of Management & Operating (M&O) contractor and subcontractor personnel.
- h. Describe the relationship between 10CFR830.120, DOE Order 5700.6C, Quality Assurance, and DOE Order 4330.4B, Maintenance Management Program, in relation to work processes and maintenance activities.
- i. Describe the relationship between DOE Order 4320.2A, Capital Asset Management Process, and DOE Order 4330.4B, Maintenance Management Program, in relation to condition assessment surveys.
- j. Describe the relationship between DOE Order 4320.1B, Site Development Planning, and DOE Order 4330.4B, Maintenance Management Program.
- k. Describe the relationship between DOE Order 4330.2C, In-house Energy Management, and DOE Order 4330.4B, Maintenance Management Program.

Chapter DOE Order 4330.4B, Maintenance Management Program

- l. Describe maintenance backlog work and identify criteria used to establish a proper magnitude of maintenance backlog.
- m. Discuss the graded approach process by which Department line management determines an appropriate level of coverage by facility maintenance management personnel. Include in this discussion factors that may influence the level of coverage.

2. Self-Study Information

Competency 1.16 and 1.17 addresses maintenance management requirements. Competency 1.16 is at a familiarity level of knowledge and Competency 1.17 at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Code of Federal Regulations, Title 10 Energy, Part 830 Nuclear Safety Management, Subpart A General Provisions, Section 120
- Site Development Planning, DOE Order 4320.1B
- Capital Asset Management Process, DOE Order 4320.2A
- In-house Energy Management, DOE Order 4330.2D
- Maintenance Management Program, DOE Order 4330.4B
- Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports, DOE-STD-1027-92
- Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities, DOE-STD-1051-93
- Guideline to Good Practices for Types of Maintenance Activities at DOE Nuclear Facilities, DOE-STD-1052-93
- Establishing and Maintaining a Facility Representative Program at DOE Nuclear Facilities, DOE-STD-1063-93
- Guideline To Good Practices For Post Maintenance Testing At DOE Nuclear Facilities, DOE-STD-1065-94
- Guideline to Good Practices for Maintenance History at DOE Nuclear Facilities, DOE-STD-1068-94
- Guide for Operational Configuration Management Program, DOE-STD-1073-93-Pt.1
- Post-Maintenance Test Programs, Office of Nuclear and Facility Safety, Safety Notice 95-04 DOE/EH-0513
- Problem Analysis and Risk Assessment Self Study Guide

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.16-1.a** and **1.17-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 9, pages 4- 7 and Section 1, page II-2.
- b. For Supporting Knowledge and Skills **1.16-1.b** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Table of Contents, pages i - v.
- c. For Supporting Knowledge and Skills **1.16-1.c** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 8.2 page II-46; Section 16.2 pages II-84 - II-85; and Section 18.3.1, page II-95.
 - Guide for Operational Configuration Management Program (DOE-STD-1073-93-Pt.1), Section 1.2, pages I-4 - I-5 and Appendix I-A, pages I-A-2 - I-A-3.
 - Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Section 4.3.4, pages 26 - 28.
- d. For Supporting Knowledge and Skills **1.16-1.d** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 10.a, page 7.
 - Guideline to Good Practices for Types of Maintenance Activities at DOE Nuclear Facilities (DOE-STD-1052-93), Section 3.4.3.6, page 12 and Section 3.4.4.7, pages 19 - 20.
- e. For Supporting Knowledge and Skills **1.16-1.e** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 5.3.3, pages II-24 - II-25.
- f. For Supporting Knowledge and Skills **1.16-1.f** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.4.7, page I-25 - I-26 and Sections 9.1, 9.2, and 9.3.1, pages II-50 - II-51.
 - Guideline To Good Practices For Post Maintenance Testing At DOE Nuclear Facilities (DOE-STD-1065-94), Sections 1.1, page 1 and Section 3.1.1 and 3.2.1, pages 6 - 7.

Chapter DOE Order 4330.4B, Maintenance Management Program

- g. For Supporting Knowledge and Skills **1.16-1.g** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.4.7, page I-25 - I-26 and Section 9.3.4, pages II-55 - II-56.
 - Guideline To Good Practices For Post Maintenance Testing At DOE Nuclear Facilities (DOE-STD-1065-94), Section 3.4.3, page 14.
 - Post-Maintenance Test Programs (Office of Nuclear and Facility Safety, Safety Notice 95-04 DOE/EH-0513) page 3.
- h. For Supporting Knowledge and Skills **1.16-1.h** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.4.9, page I-27 - I-28 and Sections 16.1 and 16.2, pages II-84 - II-85.
 - Guideline To Good Practices For Maintenance History At DOE Nuclear Facilities (DOE-STD-1068-94), Section 3.1, page 4.
- i. For Supporting Knowledge and Skills **1.16-1.i** refer to:
- Guideline To Good Practices For Maintenance History At DOE Nuclear Facilities (DOE-STD-1068-94), Section 3.4.2.1, page 7.
- j. For Supporting Knowledge and Skills **1.16-1.j** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 17.2, page II-88.
- k. For Supporting Knowledge and Skills **1.17-1.b** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 1, page 1.
- l. For Supporting Knowledge and Skills **1.17-1.c** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Sections 7 and 8, pages 3 - 4.
- m. For Supporting Knowledge and Skills **1.17-1.d** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Sections 9.a - 9.f, pages 4 - 7.
 - Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Section 2.3.1, page 4 - 6.
- n. For Supporting Knowledge and Skills **1.17-1.e** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 10, pages 7 - 9.
- o. For Supporting Knowledge and Skills **1.17-1.f** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 10.d, page 8.

Chapter DOE Order 4330.4B, Maintenance Management Program

- p. For Supporting Knowledge and Skills **1.17-1.g** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3, page 1 and Section 10, pages 7 - 9.
- q. For Supporting Knowledge and Skills **1.17-1.h** refer to:
- 10 CFR 830.120, Quality Assurance.
 - Maintenance Management Program (DOE Order 4330.4B), Section 1, page II-1.
 - Quality Assurance (DOE Order 5700.6C), Section 9.b, pages 5 - 7 and (DOE Order 5700.6C, Change 1), Attachment I, page 1.
 - Implementation Guide For Use With 10 CFR 830.120 Quality Assurance, G-830.120.
- r. For Supporting Knowledge and Skills **1.17-1.i** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.2.2, page I-15.
 - Capital Asset Management Program (DOE Order 4320.2A), Chapter I, Section 2.d, page 5.
- s. For Supporting Knowledge and Skills **1.17-1.j** refer to:
- Maintenance Management Program (DOE Order 4330.4B).
 - Site Development Planning (DOE Order 4320.1B).
- t. For Supporting Knowledge and Skills **1.17-1.k** refer to:
- Maintenance Management Program (DOE Order 4330.4B).
 - In-House Energy Management (DOE Order 4330.2D).
- u. For Supporting Knowledge and Skills **1.17-1.l** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.4.8, page I-26 - I-27 and Section 7.3.2.a, pages II-35 - II-36.
- v. For Supporting Knowledge and Skills **1.17-1.m** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 8.i, page 4; Section 10.d, page 10; Attachment 1 item 4, page 1 - 2; Section 1, pages I-1 - I-3; and Section 1, page II-2.
 - Guide for Operational Configuration Management Program (DOE-STD-1073-93-Pt.1), Section 1.4, pages I-14 - I-25.
 - Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports (DOE-STD-1027-92), Section 4.0, pages 9 - 11 and Attachment 1, pages A-1 - A-5.
 - Establishing and Maintaining a Facility Representative Program at DOE Nuclear Facilities (DOE-STD-1063-93), Section 5.1, pages 10 - 11.

Chapter DOE Order 4330.4B, Maintenance Management Program

The objectives and criteria of Quality Assurance (DOE Order 5700.6C) is recognized as being required in Maintenance Management Program (DOE Order 4330.4B), Section 1, Page II-1. The Quality Assurance Criteria associated with maintenance related work processes and activities are defined in Quality Assurance (DOE Order 5700.6C), Section 9.b, Pages 5 - 7. For Nuclear Facilities these requirements are codified under 10 CFR 830.120, Quality Assurance. Guidance for developing and implementing Quality Assurance Programs is provided by G-830.120, Implementation Guide For Use With 10 CFR 830.120 Quality Assurance, as stipulated in Quality Assurance (DOE Order 5700.6C, Change 1), Attachment I, Page 1.

Several Maintenance Management Program areas are directly related to Site Development Planning. Requirements addressed in Maintenance Management Program (DOE Order 4330.4B) have direct impact on mission requirements, utility support, building and structure condition, goals to reduce maintenance costs and modifications as they apply to the preceding items. This information is included in the Technical Site Information Plan for analysis. This information is then utilized in the preparation of a Master Site Development Plan.

When developing and/or evaluating Maintenance Management Programs identified in Maintenance Management Program (DOE Order 4330.4B) consideration should be given to energy conservation. In-House Energy Management (DOE Order 4330.2D) recognizes the following areas related to maintenance activities for evaluation: vehicle utilization, building modifications, tasks involving thermal insulation, steam trap preventive maintenance, new equipment procurement and training of personnel on energy awareness.

Maintenance Management Program (DOE Order 4330.4B), provides a discussion of the "Graded Approach" as it applies to maintenance. Further information relating to Facility hazard categorization and coverage may be found in DOE-STD-1027-92 and DOE-STD-1063-93. While maintenance is not specifically addressed, the process described would be appropriate for determining coverage by maintenance management.

Chapter DOE Order 4330.4B, Maintenance Management Program

4. Practice Exercise

- a. Within the Department of Energy, who is responsible to review the maintenance backlog and establish plans to ensure the backlog remains consistent with DOE goals and objectives? (K&S 1.16-1.a) (K&S 1.17-1.a)

- b. What guidance should field element managers, contractor managers, and staff members use for oversight of facility programs supporting maintenance? (K&S 1.16-1.a) (K&S 1.17-1.a)

- c. Identify the key elements and sub elements of a contractor maintenance plan as required by DOE Order 4330.4B, Maintenance Management Program. (K&S 1.16-1.b)

Non-nuclear Facilities	Nuclear Facilities
ELEMENT	ELEMENT
SUB-ELEMENTS	SUB-ELEMENTS
ELEMENT	ELEMENT
SUB-ELEMENTS	SUB-ELEMENTS

Chapter DOE Order 4330.4B, Maintenance Management Program

Non-nuclear Facilities	Nuclear Facilities
ELEMENT	ELEMENT
SUB-ELEMENTS	SUB-ELEMENTS
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Chapter DOE Order 4330.4B, Maintenance Management Program

Non-nuclear Facilities	Nuclear Facilities
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SUB-ELEMENTS	SUB-ELEMENTS
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Chapter DOE Order 4330.4B, Maintenance Management Program

Non-nuclear Facilities	Nuclear Facilities
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Chapter DOE Order 4330.4B, Maintenance Management Program

Non-nuclear Facilities	Nuclear Facilities
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	SUB-ELEMENTS
	ELEMENT
	SUB-ELEMENTS

- d. Describe the relationship between configuration control and maintenance work control process and the maintenance history file. (K&S 1.16-1.c)

Chapter DOE Order 4330.4B, Maintenance Management Program

- e. List examples of the items that can be used in the evaluation of Preventive Maintenance program. (K&S 1.16-1.d)

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- f. What factors should be taken into account when planning the frequency of a preventive maintenance activity? (K&S 1.16-1.e)

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- g. What factors should be taken into account when reviewing the planning of a contractor preventive maintenance activity? (K&S 1.16-1.e)

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Chapter DOE Order 4330.4B, Maintenance Management Program

- h. Discuss the importance of post-maintenance testing. (K&S 1.16-1.f)
- i. Describe the elements of an effective post-maintenance testing program. (K&S 1.16-1.f)
- A post maintenance testing program should include the following elements:
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- j. In accordance with Maintenance Management Program (DOE Order 4330.4B), who is should be assigned the responsibility for the operational acceptability of all equipment and systems following maintenance? (K&S 1.16-1.g)
- 1) The Maintenance Manager
 - 2) The maintenance supervisor
 - 3) The shift supervisor
 - 4) The operations organization

Chapter DOE Order 4330.4B, Maintenance Management Program

k. What information should be include in post-maintenance testing procedures to ensure valid results? (K&S 1.16-1.g)

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l. Discuss the importance of maintaining a maintenance history. (K&S 1.16-1.h)

Chapter DOE Order 4330.4B, Maintenance Management Program

m. What can a maintenance history file be used for?. (K&S 1.16-1.h)

Maintenance history file can be used:

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n. Concerning the review a maintenance history file: (K&S 1.16-1.i)

- 1) How often should maintenance history files be reviewed?
- 2) What is the purpose of reviewing a maintenance history file?
- 2) What action may result from the review a maintenance history file?

Chapter DOE Order 4330.4B, Maintenance Management Program

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Chapter DOE Order 4330.4B, Maintenance Management Program

r. Discuss the Department's objectives for maintenance management. (K&S 1.17-1.c)

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Chapter DOE Order 4330.4B, Maintenance Management Program

- s. Match the assigned responsibilities in column A with the positions in column B. Use the column B answers one time only. Ignore any response in column B not identified in column A. (K&S 1.17-1.d)

Column A	Column B
___ 1. Through the Contracting Officer, ensure that applicable contracts contain clauses that meet the policy and objectives of this order.	a. Secretary
___ 2. Ensure that resources are provided to maintain property in a reasonable and economic manner and to ensure that the backlog remains consistent with DOE goals and objectives.	b. Associate Deputy Secretary for Field Management
___ 3. Provide formal Departmental interpretation of the non-nuclear maintenance requirements of 4330.4B	c. Office of Chief Financial Officer
___ 4. Monitor and audit all aspects of the implementation of 4330.4B	d. Assistant Secretary for Environmental, Safety, and Health
	e. Heads of Headquarters Elements
	f. Managers of Field Elements

- t. Match the assigned responsibilities in column A with the positions in column B. Use the column B answers one time only. Ignore any response in column B not identified in column A. (K&S 1.17-1.d)

Column A	Column B
___ 1. Have clearly defined charter and objectives.	a. Maintenance Division Manager
___ 2. Establishing goals and objectives that promote safe, reliable and efficient maintenance operations.	b. Staff Assistants
___ 3. Responsible for the activities of personnel assigned.	c. Department Managers
___ 4. Duties and responsibilities clearly defined in position descriptions.	d. Committees and Task Forces

Chapter DOE Order 4330.4B, Maintenance Management Program

- u. Describe the purpose, scope and requirements of Maintenance Implementation Plans (MIPs). (K&S 1.17-1.e)

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- v. Describe the provisions to allow nuclear facility program elements to include non-nuclear equipment. (K&S 1.17-1.f)

Chapter DOE Order 4330.4B, Maintenance Management Program

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Chapter DOE Order 4330.4B, Maintenance Management Program

- y. Describe the relationship between DOE Order 5700.6C, Quality Assurance and DOE Order 4330.4B, Maintenance Management Program, in relation to work processes and maintenance activities. (K&S 1.17-1.h)

- z. What are the ten criteria requirements for a Quality Assurance program in accordance with Quality Assurance, DOE 5700.6C. (K&S 1.17-1.h)

Quality Assurance (DOE-5700.6C) establishes 10 criteria requirements in three different areas to ensure the implementation of a Quality Assurance Program.

Management	Performance	Assessment
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-	-	-
-	-	-
-	-	-

- aa. Describe the relationship between DOE Order 4320.2A, Capital Asset Management Process, and DOE Order 4330.4B, Maintenance Management Program, in relation to condition assessment surveys. (K&S 1.17-1.i)

- ab. Describe the relationship between DOE Order 4320.1B, Site Development Planning and DOE Order 4330.4B, Maintenance Management Program. (K&S 1.17-1.j)

Chapter DOE Order 4330.4B, Maintenance Management Program

- ac. Describe the relationship between DOE Order 4330.2C, In-house Energy Management, and DOE Order 4330.4B, Maintenance Management Program. (K&S 1.17-1.k)
- ad. Define maintenance backlog. (K&S 1.17-1.l)
- ae. Identify the criteria used to establish a proper magnitude of maintenance backlog. (K&S 1.17-1.i)
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- af. Why is the term "should" used in the Performance Objectives of the Maintenance Management Program rather than the expected term "shall"? Example "2.1 The organization and administration of the maintenance function should ensure that a high level of performance..." (K&S 1.17-1.m)

Chapter DOE Order 4330.4B, Maintenance Management Program

- ag. Define the term "**graded approach**". (K&S 1.17-1.m)
- ah. Discuss the graded approach process by which Department line management determines an appropriate level of coverage by facility maintenance management personnel. Include in this discussion factors that may influence the level of coverage. (K&S 1.17-1.m)
- ai. As part of an exercise for this section, review a contractor preventive maintenance activity. Describe the preventive maintenance factors to be considered as the activity is planned. Discuss the findings and recommended corrective actions, where appropriate, with your supervisor. (K&S 1.16-1.e)
- aj. As part of an exercise for this section, review several post-maintenance testing activities. Determine if the activities meet the requirements for acceptable post-maintenance testing. Ensure that the authorization bases documentation (i.e., OSR, SAR, TSR, etc.) requirements are considered. Discuss the findings and recommended corrective actions, where appropriate, with your supervisor. (K&S 1.16-1.g)
- ak. As part of an exercise for this section, obtain a copy of a maintenance history file from your supervisor. Determine if there is any indication of repeat maintenance items. Discuss the findings and recommended corrective actions, where appropriate, with your supervisor. (K&S 1.16-1.i)
- al. As part of an exercise for this section, conduct a Maintenance Problem Analysis of a site or equipment specific maintenance problem. Discuss the findings and recommended corrective actions, where appropriate, with your supervisor. (K&S 1.16-1.j)

Chapter DOE Order 4330.4B, Maintenance Management Program

5. Practice Exercise Answers

- a. Within the Department of Energy, who is responsible to review the maintenance backlog and establish plans to ensure the backlog remains consistent with DOE goals and objectives? (K&S 1.16-1.a) (K&S 1.17-1.a)

Managers of Field Elements

- b. What guidance should field element managers, contractor managers, and staff members use for oversight of facility programs supporting maintenance? (K&S 1.16-1.a) (K&S 1.17-1.a)

DOE Order 4330.4B should be used to assess the effectiveness and adequacy of contractor policies, procedures, and facility actions in the area of maintenance. Groups reviewing nuclear facility maintenance performance could use this document as a reference to support some aspects of their activities.

- c. Identify the key elements of a contractor maintenance plan as required by DOE Order 4330.4B, Maintenance Management Program. (K&S 1.16-1.b)

Non-nuclear Facilities	Nuclear Facilities
Organization, Administration, and Training	Maintenance Organization and Administration
Organization/Staffing Administration Policies, Goals, and Objectives Training and Qualification	Maintenance Organization Policies Maintenance Strategies Staffing Resources Goals and Objectives Accountability
Condition of Facilities and Equipment	Training and Qualification of Maintenance Personnel
Facility Condition Inspection by Management Condition Assessment Surveys	Responsibilities Maintenance Training Programs Training Schedules and Support On-the-Job Training Qualification Training in Root Cause Analysis Training Program Approval, Effectiveness, and Feedback Management and Supervisory Training

Chapter DOE Order 4330.4B, Maintenance Management Program

Non-nuclear Facilities	Nuclear Facilities
Maintenance Documentation	Maintenance Facilities, Equipment and Tools
Site Maintenance Plan	Facilities Tools and Equipment Storage Office Equipment
Work Control System	Types of Maintenance
Work Request (Order) System Formal Job Planning and Estimating Work Performance (Time) Standards Priority System Maintenance Procedures and Other Work-Related Documents Scheduling System Post-Maintenance Testing Backlog Work Order Control Equipment Repair History and Vendor Information	Master Equipment List (MEL) Types of Maintenance Maintenance Action and Frequency Selection Scheduling
Maintenance Facilities, Equipment, and Materials Control System	Maintenance Procedures
Maintenance Facilities, Equipment, and Tools Requisitioning/Procurement Materials Control Control and Calibration of Measuring and Test Equipment Maintenance Tools and Equipment Controls	Procedure Development and Writing Procedure Verification Procedure Validation Procedure Approval Procedure Use Procedure Control, Periodic Review, and Revision
Implementation of Maintenance Activities	Planning, Scheduling, and Coordination of Maintenance
Surveillance and Preventive Maintenance Predictive Maintenance Corrective (Repair) Maintenance Modification Work	Planning for Maintenance Activities Scheduling Maintenance Activities Coordination of Maintenance Activities Outage Planning, Scheduling, and Coordination

Chapter DOE Order 4330.4B, Maintenance Management Program

Non-nuclear Facilities	Nuclear Facilities
Maintenance Evaluation and Analysis	Control of Maintenance Activities
Analysis of Root Causes of Problems Periodic Review and Analysis Performance Measurement and Improvement Management Involvement Work Sampling Cost and Identification Control Audits and Lessons Learned	Work Control Procedures Work Requests Supervision of Maintenance Activities Review of Completed Work Requests Temporary Repairs Control of Non-facility Contractor and Subcontractor Personnel
	Post-Maintenance Testing
	Post-Maintenance Test Requirements Post-Maintenance Test Program Scope Post-Maintenance Test Control Post-Maintenance Test Performance, Documentation, and Acceptance
	Procurement of Parts, Materials, and Services
	Procurement Policy and Procedures Procurement Initiation Procurement Control Services
	Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance
	Receipt and Inspection Handling Storage Material and Equipment Retrieval and Issuance
	Control and Calibration of Measuring and Test Equipment
	Identification Calibration Control Evaluation

Chapter DOE Order 4330.4B, Maintenance Management Program

Non-nuclear Facilities	Nuclear Facilities
	Maintenance Tools and Equipment Control
	Storage and Issuance Tool and Equipment Maintenance Use of Special Tools and Equipment
	Facility Condition Inspection
	Standards Training Procedures Scope of Inspections Inspection Program Elements Reporting Deficiencies Deficiency Follow up
	Management Involvement
	Manager Involvement Performance Indicators, Goals, and Objectives Feedback Program Reviews
	Maintenance History
	Program Development Data Collection Program Use
	Analysis of Maintenance Problems
	Information Collection Event Analysis Cause Determination Corrective Action Corrective Action Followup Generic Followup
	Modification Work

Chapter DOE Order 4330.4B, Maintenance Management Program

Non-nuclear Facilities	Nuclear Facilities
	Maintenance Program Interface with Modifications Temporary Repairs/Temporary Modifications
	Additional Maintenance Management Requirements
	Seasonal Facility Preservation Requirements

- d. Describe the relationship between configuration control and maintenance work control process and the maintenance history file. (K&S 1.16-1.c)

Guide for Operational Configuration Management Program (DOE-STD-1073-93-Pt.1), cites DOE 4330.4A. The Maintenance Management Program establishes DOE expectations regarding the conduct of maintenance activities on various equipment, including repairable or replaceable equipment and non-replaceable facility life-limiting equipment, at both DOE nuclear and non-nuclear facilities. The maintenance activities are designed to provide assurance that the physical configuration is maintained within its design requirements. DOE 4330.4B includes DOE policy that directly relates to material condition and aging management: "Structures, systems, and components that are important to safe operation shall be subject to a maintenance program in order to meet or exceed their design requirements throughout their life."

DOE 4330.4B does not provide technical guidance on how the measurement are to be established or how degradation is to be forecasted. Configuration Management (CM) program has an adjunct program, Material Condition and Aging (MCA) Management, that develops analytical methods and testing techniques that can be used to meet the requirements of the maintenance program.

The Configuration Management (CM) program also interfaces with the Maintenance Management program through the change control and document control elements, which address the control of hardware and procedure changes. Within the maintenance program, the main interface is with the work control process (§ 3.4 page I-17 and § 8.3 page II-46), which manages and sequences maintenance activities in the field. Another important interface exists between preventive and predictive maintenance activities and the performance monitoring function of the assessment element of the Configuration Management program.

Chapter DOE Order 4330.4B, Maintenance Management Program

- e. List examples of the items that can be used in the evaluation of Preventive Maintenance program. (K&S 1.16-1.d)
- craftsperson feedback on adequacy of PM procedures
 - quality assurance audit reports and self assessment findings
 - failure trend reports for plant and industry equipment
 - licensee event reports
 - non-conformance reports
 - material deficiency reports
 - causes for deferrals
- f. What factors should be taken into account when planning the frequency of a preventive maintenance activity? (K&S 1.16-1.e)
- regulatory and code requirements;
 - vendor recommendations;
 - experience at this and similar facilities;
 - maintenance history;
 - engineering judgement;
 - cost/benefit engineering;
 - available personnel;
 - minimizing personnel radiation exposure using ALARA principles;
 - function, ease of replacement, and demonstrated reliability of equipment or system;
 - optimizing equipment or system availability during unit operating conditions; and
 - operating history.
- g. What factors should be taken into account when reviewing the planning of a contractor preventive maintenance activity? (K&S 1.16-1.e)
- the complexity of the job will require different levels of planning;
 - definition of the problem and identification of the work scope;
 - identification and review of procedures, drawings, vendor manuals, and maintenance history;
 - identification of needed and available data for use in analysis of maintenance problems;
 - procurement of necessary repair parts, materials, tools, and equipment;
 - assessment of staffing and skill requirements for facility, non-facility, and subcontractor personnel;
 - identification and review of resources including other tasks scheduled to occur in the immediate area during the same time period;
 - pre-job ALARA planning;
 - identification of initial conditions and prerequisites, including applicable technical specifications and limiting conditions of operation;
 - identification of quality control inspection, code, and technical specification

Chapter DOE Order 4330.4B, Maintenance Management Program

- requirements;
- establishment of equipment restoration and post-maintenance inspection or testing requirements; and
- review of work instructions or work package completeness.

h. Discuss the importance of post-maintenance testing. (K&S 1.16-1.f)

Post maintenance testing is used to verify that the maintenance was performed correctly and that the equipment operates correctly and performs its desired function.

Post maintenance testing is performed to ensure that equipment performs its intended function when returned to service following maintenance, that the original deficiency is corrected, and that a new deficiency has not been created.

i. Describe the elements of an effective post-maintenance testing program. (K&S 1.16-1.f)

A post maintenance testing program should include the following elements:

- Assigning responsibility for determining post maintenance test requirements using functional groups such as operations, maintenance, and technical support.
- Determining the scope of the post maintenance testing program to help ensure that appropriate levels of testing are applied to facility equipment and that redundant testing is minimized.
- Tracking the status of equipment that has undergone maintenance to ensure all testing is completed prior to work closeout.
- Conducting proper post maintenance tests (PMT), documenting the results, and verifying that the resulting data meet acceptance criteria.
- Guidance is available to planners for identifying appropriate tests.
- Testing is conducted under the appropriate system operating parameters.
- A form is used to authorize, document, and review the results of PMT.
- Post-test system restoration is formally controlled (restoring system to normal and/or standby modes following completion of PMT).

Chapter DOE Order 4330.4B, Maintenance Management Program

- j. In accordance with Maintenance Management Program (DOE Order 4330.4B), who is should be assigned the responsibility for the operational acceptability of all equipment and systems following maintenance? (K&S 1.16-1.g)

- 1) The Maintenance Manager
- 2) The maintenance supervisor
- 3) The shift supervisor

4) The operations organization

- k. What information should be include in post-maintenance testing procedures to ensure valid results? (K&S 1.16-1.g)

- Initial conditions and prerequisites
- hold points
- cautions
- personnel qualifications requirements
- personnel safety requirements
- clear acceptance criteria
- post test restoration
- information should be specific as possible and avoid vague criteria
- test equipment should be specified and provision made for recording equipment identification and calibration due date

- l. Discuss the importance of maintaining a maintenance history. (K&S 1.16-1.h)

Maintenance history and trending program should be maintained to document data, provide historical information for maintenance planning, and support maintenance and performance trending of facility systems and components.

Maintenance history programs can be used to improve:

- the balance of corrective and preventive maintenance (DOE 4330.4B paragraph 5)
- the planning, scheduling, and coordination of maintenance (DOE 4330.4B paragraph 7)
- the analysis of maintenance problems (DOE 4330.4B paragraph 17).

Maintenance history file can be used by plant management to identify trends that indicate a need for corrective action and by work planners as a reference to assist in the work planning process.

Chapter DOE Order 4330.4B, Maintenance Management Program

m. What can a maintenance history file be used for?. (K&S 1.16-1.h)

Maintenance history file can be used:

- Failure analysis (provides some of the data needed to support analyzing and trending failures)
- conduct of maintenance assessments (provides an input to identify rework for the purpose of identifying maintenance program improvements)
- preventive maintenance (provides some of the data useful for identifying and justifying preventive maintenance program changes)
- outages planning (provides some of the data useful for post outage evaluation and as a basis for planning the next outage)
- post maintenance test planning
- ALARA program (provides work time data useful for radiological exposure evaluation and planning)
- budget preparation (provides an input for determining future maintenance needs based on experience and a justification for these expenditures)
- review of DOE and industry experience, vendor information, and other documents to assess plant specific applicability
- conduct of maintenance assessment (provides an input to identifying maintenance program improvements)
- facility life extension (provides some of the data needed to support extension of plant design life)
- contributes greatly to avoiding and understanding failures (DOE 4330.4B paragraph 17).

n. Concerning the review a maintenance history file: (K&S 1.16-1.i)

1) How often should maintenance history files be reviewed?

DOE-STD-1068-94 suggests that component files be reviewed at least every two years.

2) What is the purpose of reviewing a maintenance history file?

The purpose of the review is to determine if recurring maintenance problems or other performance trends indicate a need for corrective maintenance. The assigned engineer should determine the probable cause and recommend a course of action.

2) What action may result from the review a maintenance history file?

The review may result in corrective maintenance, component modification or replacement, a change in preventive or predictive maintenance schedule, or a change in procedure.

Chapter DOE Order 4330.4B, Maintenance Management Program

- o. Explain the intent of a Maintenance Problem Analysis Program. (K&S 1.16-1.j)
Systematic analysis should be used to determine and correct the root causes of unplanned occurrences related to maintenance. Maintenance management (§ 16) provides guidance for collecting and trending maintenance history for recurring or persistent equipment failures that should be reviewed by the analysis program. Incident reports, post-trip reviews, and other similar operating experience methods supplement the maintenance history program and provide data, including human error data, which should be reviewed by the analysis program.

An analysis program may be used effectively to reduce recurring maintenance problems by identifying and resolving root causes of the problem.

- p. Explain the intent of DOE Order 4330.4B, Maintenance Management Program. (K&S 1.17-1.b)
The purpose of DOE Order 4330.4B, Maintenance Management Program, is to provide a general policy and objectives for the establishment of programs for the management and performance of cost effective maintenance and repair of Department of Energy property.
- q. Discuss the Department's policy for maintenance management. (K&S 1.17-1.c)
- The maintenance management program for all DOE property be consistent with this order and that all DOE property be maintained in a manner which promotes operational safety, worker health, environmental protection and compliance, property preservation, and cost-effectiveness while meeting the programmatic mission.
 - Structures, systems, and components that are important to safe operation shall be subject to a maintenance program in order to meet or exceed their design requirements throughout their life.
 - Periodic inspection of structures, systems, components, and equipment be performed to determine deterioration or technical obsolescence which threaten performance and/or safety.
 - Primary responsibility, authority, and accountability for the direction and management of the maintenance programs for all property reside with the line management assigned direct programmatic responsibility.

Chapter DOE Order 4330.4B, Maintenance Management Program

- r. Discuss the Department's objectives for maintenance management. (K&S 1.17-1.c)
- Develop a cost effective and efficient maintenance program for all DOE property that is consistent with DOE's mission, safety and health, reliability, quality, and environmental protection objectives.
 - Establish a review and analysis capability for evaluation of maintenance program performance and effectiveness.
 - Ensure the reliability, safety, and operability of structures, systems, and components.
 - Ensure compliance with environmental, safety, and health standards.
 - Ensure that the responsibility, authority, and accountability for maintenance are clearly defined and appropriately assigned.
 - Ensure that, where maintenance requirements or accepted maintenance standards cannot be met, such instances are appropriately documented and acknowledged by line management.
 - Ensure that sufficient resources are budgeted in a timely manner to accomplish the maintenance program.
 - Ensure that effective programs are in place to evaluate and measure property condition.
 - Ensure that a graded approach is taken by line management in the development and implementation of maintenance programs.
 - Ensure that the maintenance of DOE property meets the equivalent guidelines, as appropriate, as required for the conduct of maintenance in commercial industry.

Chapter DOE Order 4330.4B, Maintenance Management Program

- s. Match the assigned responsibilities in column A with the positions in column B. Use the column B answers one time only. Ignore any response in column B not identified in column A. (K&S 1.17-1.d)

Column A	Column B
f 1. Through the Contracting Officer, ensure that applicable contracts contain clauses that meet the policy and objectives of this order.	a. Secretary
	b. Associate Deputy Secretary for Field Management
e 2. Ensure that resources are provided to maintain property in a reasonable and economic manner and to ensure that the backlog remains consistent with DOE goals and objectives.	c. Office of Chief Financial Officer
	d. Assistant Secretary for Environmental, Safety, and Health
	e. Heads of Headquarters Elements
b 3. Provide formal Departmental interpretation of the non-nuclear maintenance requirements of 4330.4B	f. Managers of Field Elements
d 4. Monitor and audit al aspects of the implementation of 4330.4B	

- t. Match the assigned responsibilities in column A with the positions in column B. Use the column B answers one time only. Ignore any response in column B not identified in column A. (K&S 1.17-1.d)

Column A	Column B
d 1. Have clearly defined charter and objectives.	a. Maintenance Division Manager
	b. Staff Assistants
a 2. Establishing goals and objectives that promote safe, reliable and efficient maintenance operations.	c. Department Managers
	d. Committees and Task Forces
c 3. Responsible for the activities of personnel assigned.	
b 4. Duties and responsibilities clearly defined in position descriptions.	

Chapter DOE Order 4330.4B, Maintenance Management Program

- u. Describe the purpose, scope and requirements of Maintenance Implementation Plans (MIPs). (K&S 1.17-1.e)

The Maintenance Implementation Plan shall clearly define:

- The structures, systems, and components included, using a graded approach and the requirements derived from Technical Safety Requirements.
- The management systems used to control maintenance activities, including the means for monitoring and measuring the effectiveness of the program and the management of maintenance backlog.
- The assignment of responsibilities and authority for all levels of the maintenance organization.
- Mechanisms for feedback of relevant information, such as trend analysis and instrument performance/reliability data, to identify necessary program modifications.
- Provisions for identification, evaluation, and correction of possible components, system design, quality assurance, or other relevant problems.
- Performance indicators and criteria to be utilized to measure equipment, systems, and personnel effectiveness in maintenance activities.
- Interfaces between maintenance and other organizations (i.e., operations; engineering; quality; training; and environment, safety, and health)
- A self assessment program to monitor the effectiveness and efficiency of the maintenance program.
- Provisions for planning, scheduling, and coordination of maintenance activities.

- v. Describe the provisions to allow nuclear facility program elements to include non-nuclear equipment. (K&S 1.17-1.f)

DOE nuclear facility maintenance programs may include facility-related non-nuclear equipment provided the Maintenance Implementation Plan clearly identifies all equipment (or systems) and distinguishes those non-nuclear equipment/systems.

Chapter DOE Order 4330.4B, Maintenance Management Program

- w. Discuss the requirements for the control of Management & Operating (M&O) contractor and subcontractor personnel. (K&S 1.17-1.g)

Non-facility contractor and sub-contractor personnel who perform maintenance or modifications on facility systems should be trained and qualified for the work they are to perform. These personnel should also receive general employee training and specific training in appropriate facility administration, safety, quality control, and radiation protection procedures and practices. Adequate time should be provided for this training. Recognition should be given to individual needs and previous training experience. Experienced personnel may be allowed to bypass training by providing proficiency through examination and demonstration. Non-facility contractor and sub-contractor personnel who are not fully trained and qualified for the job to be performed should be continually supervised by qualified personnel.

Non-facility contractor and sub-contractor personnel should perform maintenance under the same controls as, and to the same high work standards expected of, facility maintenance personnel. Non-facility contractor and sub-contractor managers and supervisors should be held accountable for the work performance of their personnel. Facility supervisors should review the work of these personnel during preparation for work, at the job site, and during post maintenance testing and acceptance inspections to extent needed to enforce these requirements.

Use of sub-contractor personnel to perform routine facility maintenance should not be relied upon to the extent that it deters the development of permanent staff expertise.

- x. Describe the relationship between 10CFR830.120, DOE Order 5700.6C, Quality Assurance, and DOE Order 4330.4B, Maintenance Management Program, in relation to work processes and maintenance activities. (K&S 1.17-1.h)

Title 10 Code of Federal Regulations Part 830 Nuclear Safety Management governs the conduct of the Department of Energy (DOE) management and operating contractors and other persons at DOE nuclear facilities. Subpart A Section 120 deals with Quality Assurance. The section requires a Quality Assurance Plan (QAP) be developed, implemented, and maintained. The performance section requires work to be performed to establish technical standards and administrative controls using approved instructions, procedures, or other appropriate means. Items shall be maintained to prevent their damage, loss, or deterioration. Equipment used for process monitoring or data collection shall be calibrated and maintained.

Chapter DOE Order 4330.4B, Maintenance Management Program

- y. Describe the relationship between DOE Order 5700.6C, Quality Assurance and DOE Order 4330.4B, Maintenance Management Program, in relation to work processes and maintenance activities. (K&S 1.17-1.h)

The Maintenance Management Program, (DOE Order 4330.4B), specifically cites that "The Quality Assurance (QA) programs specified by the reference in Paragraph 5m, page 3 (Quality Assurance, DOE-5700.6C), are applied to maintenance activities commensurate with their safety and security significance."

- z. What are the ten criteria requirements for a Quality Assurance program in accordance with Quality Assurance, DOE 5700.6C. (K&S 1.17-1.h)

Quality Assurance (DOE-5700.6C) establishes 10 criteria requirements in three different areas to ensure the implementation of a Quality Assurance Program.

Management	Performance	Assessment
-Program -Personnel Training and Qualification -Quality Improvement -Documents and Records	-Work Processes -Design -Procurement -Inspection and Acceptance Testing	-Management Assessment -Independent Assessment

- aa. Describe the relationship between DOE Order 4320.2A, Capital Asset Management Process, and DOE Order 4330.4B, Maintenance Management Program, in relation to condition assessment surveys. (K&S 1.17-1.i)

The Condition Assessment Survey (CAS) addressed in DOE Order 4320.2A, is used to identify deficiencies in site assets. The CAS can be used to meet the needs of the facility inspection requirements of DOE Order 4330.4B.

- ab. Describe the relationship between DOE Order 4320.1B, Site Development Planning and DOE Order 4330.4B, Maintenance Management Program. (K&S 1.17-1.j)

Several Maintenance Management Program areas are directly related to Site Development Planning. Requirements addressed in Maintenance Management Program (DOE Order 4330.4B) have direct impact on mission requirements, utility support, building and structure condition, goals to reduce maintenance costs and modifications as they apply to the preceding items. This information is included in the Technical Site Information Plan for analysis. This information is then utilized in the preparation of a Master Site Development Plan.

Chapter DOE Order 4330.4B, Maintenance Management Program

- ac. Describe the relationship between DOE Order 4330.2C, In-house Energy Management, and DOE Order 4330.4B, Maintenance Management Program. (K&S 1.17-1.k)

When developing and/or evaluating Maintenance Management Programs identified in Maintenance Management Program (DOE Order 4330.4B) consideration should be given to energy conservation. In-House Energy Management (DOE Order 4330.2D) recognizes the following areas related to maintenance activities for evaluation: vehicle utilization, building modifications, tasks involving thermal insulation, steam trap preventive maintenance, new equipment procurement and training of personnel on energy awareness.

- ad. Define maintenance backlog. (K&S 1.17-1.l)

The amount of maintenance and repair work not accomplished that is needed or planned to sustain the assigned mission.

- ae. Identify the criteria used to establish a proper magnitude of maintenance backlog. (K&S 1.17-1.l)

- The maintenance backlog is measured in estimated work-hours and the number of work requests. This is used to adjust staffing, as required.
- The maintenance backlog is monitored to ensure that proper priority is given to facility conditions important to safety, environment, and facility mission.
- Deferred critical facility maintenance work is documented and justified in writing by management.
- Backlog is managed on the basis of prioritization.
- Budget and staffing levels are evaluated against both the planned maintenance and the amount of work in the backlog.

- af. Why is the term "should" used in the Performance Objectives of the Maintenance Management Program rather than the expected term "shall"? Example "2.1 The organization and administration of the maintenance function should ensure that a high level of performance..." (K&S 1.17-1.m)

This is to emphasize the use of the graded approach in developing the required maintenance implementation plans. It is expected that contractors may use different approaches or methods than those defined in the guidelines.

Chapter DOE Order 4330.4B, Maintenance Management Program

ag. Define the term "**graded approach**". (K&S 1.17-1.m)

The level of analysis, documentation, and actions necessary to comply with a requirement in the Order are commensurate with:

- The relative importance to safety, safeguards, and security
- The magnitude of any hazard involved
- The stage of the facility's life cycle
- The programmatic mission of the facility
- The particular characteristics of the facility, and
- Any other relevant factor.

ah. Discuss the graded approach process by which Department line management determines an appropriate level of coverage by facility maintenance management personnel. Include in this discussion factors that may influence the level of coverage. (K&S 1.17-1.m)

Maintenance Management Program (DOE Order 4330.4B), provides a discussion of the "Graded Approach" as it applies to maintenance. Further information relating to Facility hazard categorization and coverage may be found in DOE-STD-1027-92 and DOE-STD-1063-93. While maintenance is not specifically addressed, the process described would be appropriate for determining coverage by maintenance management.

ai. As part of an exercise for this section, review a contractor preventive maintenance activity. Describe the preventive maintenance factors to be considered as the activity is planned. Discuss the findings and recommended corrective actions, where appropriate, with your supervisor. (K&S 1.16-1.e)

aj. As part of an exercise for this section, review several post-maintenance testing activities. Determine if the activities meet the requirements for acceptable post-maintenance testing. Ensure that the authorization bases documentation (i.e., OSR, SAR, TSR, etc.) requirements are considered. Discuss the findings and recommended corrective actions, where appropriate, with your supervisor. (K&S 1.16-1.g)

ak. As part of an exercise for this section, obtain a copy of a maintenance history file from your supervisor. Determine if there is any indication of repeat maintenance items. Discuss the findings and recommended corrective actions, where appropriate, with your supervisor. (K&S 1.16-1.i)

al. As part of an exercise for this section, conduct a Maintenance Problem Analysis of a site or equipment specific maintenance problem. Discuss the findings and recommended corrective actions, where appropriate, with your supervisor. (K&S 1.16-1.j)

Competency 1.18

Facility maintenance management (FAC# 4.4) personnel shall demonstrate the ability to conduct independent assessments of a contractor's compliance with the requirements of DOE Order 4330.4B, Maintenance Management Program.

1. Supporting Knowledge and/or Skills

- a. Establish the criteria to be used as a basis for conducting the evaluation.
- b. Establish the points of contact with the field organization being evaluated.
- c. Gather information pertinent to the evaluation by interviewing personnel, observing maintenance activities and reviewing maintenance records.
- d. Document the results of data collection in field notes.
- e. Compare the results of the review phase with the criteria established for the evaluation and determine if deficiencies exist.
- f. Document the results of the overall evaluation in a formal written report which includes the status of meeting the established criteria, identifies deficiencies or good practices, and suggests recommendations for improvement.
- g. Resolve conflicting or inconclusive observations or findings obtained from other evaluators on an evaluation team.
- h. Verbally report the results of the evaluation to contractor facility management and Department management.
- i. Perform follow-up activities as applicable to ensure implementation of corrective actions, including tracking and close-out.

To participate in an assessment, contact your supervisor or Quality organization to make the necessary arrangements.

2. Self-Study Information

Competency 1.18 addresses conduct independent assessments of a contractor's compliance. Competency 1.18 is at a demonstrate the ability level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities, DOE-STD-1051-93
- Operations Assessments, DOE-EM-STD-5505-96¹
- Guidelines for Evaluation of Nuclear Facility Training Programs, DOE-STD-1070-94
- Planning and Conduct of Operational Readiness Reviews, DOE-STD-3006-93
- Savannah River Implementing Procedure (SRIP) 5700.6.12B, SR Technical Assessment Program, Attachment B, Conduct of Field Personnel, or use applicable site documents.
- Savannah River Site Lead Assessor/Auditor Training course number QAT115, Student Manual
- Kerzner Ph.D., Harold (1989 Third Edition). Project Management, A Systems Approach to Planning, Scheduling, and Controlling. New York, NY: Van Nostrand Reinhold. ISBN 0-442-20751-4. Call# HD69.P75K47.
- DOE Conduct of Assessments Topical Area Self Study Guide (SR-TA-COA-SSG-01)

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.18-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.7.7, pages I-45 - I-46 and Section 15.3.4, pages II-81 - II-82.
 - Operations Assessments (DOE-EM-STD-5505-96), Section 4.2, page 4 and Section 5.4, pages 9 - 13.
 - Savannah River Site Lead Assessor/Auditor Training Chapter 3, Section 3.1; Section 3.2.3; and Section 3.3.4.
- b. For Supporting Knowledge and Skills **1.18-1.b** refer to:
 - Operations Assessments (DOE-EM-STD-5505-96), Section 5.4.1.2, pages 10 - 11.

¹ While this reference was designed for the EM Assessment Program, it is an excellent source of general assessment program process information.

- c. For Supporting Knowledge and Skills **1.18-1.c** refer to:
- Operations Assessments (DOE-EM-STD-5505-96), Section 5.8, pages 14 - 25.
 - Savannah River Site Lead Assessor/Auditor Training Chapter 6, Sections 4.0 through 4.7.
 - Savannah River Implementing Procedure (SRIP) 5700.6.12B, SR Technical Assessment Program, Attachment B, Conduct of Field Personnel, or use applicable site documents.
- d. For Supporting Knowledge and Skills **1.18-1.d** refer to:
- Operations Assessments (DOE-EM-STD-5505-96), Section 5.8.1.2, page 16.
 - Savannah River Site Lead Assessor/Auditor Training Chapter 6, Sections 4.0 through 4.7.
 - Savannah River Implementing Procedure (SRIP) 5700.6.12B, SR Technical Assessment Program, Attachment B, Conduct of Field Personnel, or use applicable site documents.
- e. For Supporting Knowledge and Skills **1.18-1.e** refer to:
- Operations Assessments (DOE-EM-STD-5505-96), Section 5.10, pages 27 - 28 and Section 5.11, pages 28 - 29.
 - Savannah River Site Lead Assessor/Auditor Training Chapter 10.
- f. For Supporting Knowledge and Skills **1.18-1.f** refer to:
- Operations Assessments (DOE-EM-STD-5505-96), Section 5.12.1, page 29 and Appendix G, pages 143 - 170.
 - Savannah River Site Lead Assessor/Auditor Training Chapter 13; Chapter 14; and Chapter 15.
 - Guidelines for Evaluation of Nuclear Facility Training Programs, DOE-STD-1070-94, Section 7 and Section 8.
 - Planning and Conduct of Operational Readiness Reviews, DOE-STD-3006-93.
- g. For Supporting Knowledge and Skills **1.18-1.g** refer to:
- Operations Assessments (DOE-EM-STD-5505-96), Appendix B, page 134 and Section 5.11, pages 28 - 29.
 - Savannah River Site Lead Assessor/Auditor Training, Chapter 7.
 - Kerzner, Harold Ph.D., Project Management, A Systems Approach to Planning, Scheduling, and Controlling Chapter 7, Section 6.
- h. For Supporting Knowledge and Skills **1.18-1.h** refer to:
- Operations Assessments (DOE-EM-STD-5505-96), Section 5.9, page 26 and Section 5.13, page 30.
 - Savannah River Site Lead Assessor/Auditor Training, Chapter 13.

- i. For Supporting Knowledge and Skills **1.18-1.i** refer to:
- Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Section 4.3.2.e, page 24.
 - Operations Assessments (DOE-EM-STD-5505-96), Sections 4.2.4 and 4.2.5, page 6.
 - Savannah River Site Lead Assessor/Auditor Training Chapter 13; Chapter 14; and Chapter 15.
 - Guidelines for Evaluation of Nuclear Facility Training Programs, DOE-STD-1070-94, Section 7 and Section 8.

4. Practice Exercise

- a. Concerning the evaluation of maintenance program elements: (K&S 1.18-1.a)
 - 1) How often should each maintenance program element be evaluated?

 - 2) Who should have input to the evaluation process?

- b. List examples of maintenance program elements that should be evaluated. (K&S 1.18-1.a)
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- c. How can the points of contact of the maintenance organization be established. (K&S 1.18-1.b)

- d. What type of questions should be used in the interview process **AND** why? (K&S 1.18-1.c)

- e. When and where should interviews be conducted? (K&S 1.18-1.c)

- f. In preparing for and conducting observations, what actions can assist the evaluator in data collection with field notes. (K&S 1.18-1.d)
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- g. What is the importance of note taking? (K&S 1.18-1.d)

- h. What information should be included in evaluator notes? (K&S 1.18-1.d)

- i. What is the difference between a "FINDING" and a "CONCERN"? (K&S 1.18-1.e)

- j. In accordance with Operations Assessments (DOE-EM-STD-5505-96), what sections should be contained in the final report. (K&S 1.18-1.f)
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- k. In accordance with Guidelines for Evaluation of Nuclear Facility Training Programs (DOE-STD-1070-94) and Planning and Conduct of Operational Readiness Reviews (DOE-STD-3006-93), what sections should be contained in the final assessment report. (K&S 1.18-1.f)
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- l. In accordance with Operations Assessments (DOE-EM-STD-5505-96), what methodology should be used to develop a consensus on the concerns developed? (K&S 1.18-1.g)

- m. In accordance with Operations Assessments (DOE-EM-STD-5505-96), if there is a disagreement over the wording or inclusion of a concern, what should be done with the concern? (K&S 1.18-1.g)
- 1) If not all team members can agree the concern should not be included.
 - 2) Poll team members, if two thirds agree with the concern it should be included.
 - 3) The team leader should decide in cases of split opinions.
 - 4) Poll team members, majority rules and the team leader breaks ties.
- n. Who is responsible for reporting the results of the evaluation to contractor facility management and Department management? (K&S 1.18-1.h)
- o. Who should attend the assessment out-brief (exit meeting)? (K&S 1.18-1.h)
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- i. You are assigned as an assessor and are to report the results to Management, describe the three (3) main parts of the presentation and the areas addressed in each of the areas. (K&S 1.18-1.h)
- 1)
 - 2)
 - 3)

- p. In accordance with Operations Assessments (DOE-EM-STD-5505-96), discuss the information exchange occurring at the Assessment Out-briefing. (K&S 1.18-1.h)
- q. Perform follow-up activities as applicable to ensure implementation of corrective actions, including tracking and close-out. (K&S 1.18-1.i)
- r. In accordance with Operations Assessments (DOE-EM-STD-5505-96), the assessment results can be used by Field Element managers as a factor in determining contractor monetary incentives. What three (3) items should the Field Element manager consider when determining the incentives? (K&S 1.18-1.i)
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5. Practice Exercise Answers

- a. Concerning the evaluation of maintenance program elements: (K&S 1.18-1.a)
- 1) How often should each maintenance program element be evaluated?
At least every other year
 - 2) Who should have input to the evaluation process?
Managers and supervisors from maintenance and other groups such as operations, technical staff, and appropriate corporate departments.
- b. List examples of maintenance program elements that should be evaluated. (K&S 1.18-1.a)
- equipment failures and their impact on facility operations
 - identification and analysis of repetitive corrective maintenance on the same or similar equipment
 - current condition of equipment and systems
 - number and types of deferred and missed maintenance actions
 - occurrences of improper radiological control or industrial safety practices
 - occurrences of improper tool usage or failure to prevent foreign material from entering systems
 - personnel needs and part expenditures
 - occurrences of tools, equipment, or facility inadequacies
 - equipment accessibility or laydown problems
 - planning, scheduling, and coordination problems
 - the number and age of backlogged corrective maintenance requests.
- c. How can the points of contact of the maintenance organization be established. (K&S 1.18-1.b)
- Depending on the nature and extent of the assessment, the points of contact can be established by contacting the Maintenance Manager or obtaining the organizational charts.
- d. What type of questions should be used in the interview process **AND** why? (K&S 1.18-1.c)
- Open-ended questions, provides a large amount of information about the topic of interest to the assessor. The interviewee does most of the talking in responding to open-ended questions, and the information is generally volunteered.
- Closed-ended questions, they allow the interviewer to obtain specific information about a topic of interest, are less time consuming to answer, and are easier to record.

- e. When and where should interviews be conducted? (K&S 1.18-1.c)
Interviews should be conducted while observing observations and document reviews. Interviews can be scheduled separately if the interview will interfere with the performance of the duties. Crafts personnel and workers can be interviewed at their work locations, managers can be interviewed in their offices.
- f. In preparing for and conducting observations, what actions can assist the evaluator in data collection with field notes. (K&S 1.18-1.d)
- be familiar with the anticipated operations, review documentation and procedures before the observation.
 - be familiar with the guidelines of the topic being evaluated and use the guidelines as an expectation baseline.
 - pay close attention to ensure every detail is taken in and recorded
 - follow your intuition. If something does not look right or seem right, check further. Assume your intuition is correct until your research proves otherwise.
 - take copious notes. this will make it easier to follow up on your observation.
 - data gathered from observations being performed should be verified and cross checked by the following methods:
 - observe the same operation being performed by different personnel,
 - observe different operations on the same shift, or
 - observe different shifts performing similar operations.
- g. What is the importance of note taking? (K&S 1.18-1.d)
Since the burden of proof is placed on the evaluator, ample evidence must be gathered to support the conclusion.
- h. What information should be included in evaluator notes? (K&S 1.18-1.d)
Time (including month, day, year, and hour); identities (including number, model, revision, name, title); objective evidence quality; relationship to governing documents or criteria; and relationship to process, activity, or product.

The evaluator should remember it is easier to dispose of excess notes than to reconstruct objective evidence from insufficient notes.

- i. What is the difference between a "FINDING" and a "CONCERN"? (K&S 1.18-1.e)
- A finding is an individual item that does not meet requirements.
 - A concern is a determination of a programmatic breakdown or widespread problem supported by one or more findings.

Findings are facts and are observable evidence of deviations from policy, procedure, or requirements in a DOE Order or activity policy or procedure. Concerns are issues that management must address in order to eliminate the recurrence of findings.

- j. In accordance with Operations Assessments (DOE-EM-STD-5505-96), what sections should be contained in the final report. (K&S 1.18-1.f)
- Introduction
 - Concerns
 - Findings
 - Assessment Team Members
- k. In accordance with Guidelines for Evaluation of Nuclear Facility Training Programs (DOE-STD-1070-94) and Planning and Conduct of Operational Readiness Reviews (DOE-STD-3006-93), what sections should be contained in the final assessment report. (K&S 1.18-1.f)
- | | |
|---|--|
| <ul style="list-style-type: none"> • Cover Page • Background • Results and Recommendations | <ul style="list-style-type: none"> • Summary • Description of Assessment • Conclusion |
|---|--|
- l. In accordance with Operations Assessments (DOE-EM-STD-5505-96), what methodology should be used to develop a consensus on the concerns developed? (K&S 1.18-1.g)

Prior to the concern consensus meeting all identified findings should be made available to all team members. DOE-EM-STD-5505-96 suggests posting the findings of all assessors on the meeting room walls. Each assessor should develop a list of preliminary concerns based on the entire team's findings. The team leader should facilitate the consensus meeting. It is recommended that the leader choose one team member to introduce and explain the concerns that the team member developed. The assessor should present concerns one at a time, explaining the evidence that supports it. The team should discuss each concern as it is presented. The wording and scope of the concern should be discussed and changed as necessary to ensure the concern accurately reflects the conditions in the activity. The concern can be discarded if there is not sufficient evidence to support it. The process should continue until all assessors have presented their concerns and the team has reached consensus on the final list.

- m. In accordance with Operations Assessments (DOE-EM-STD-5505-96), if there is a disagreement over the wording or inclusion of a concern, what should be done with the concern? (K&S 1.18-1.g)
- 1) If not all team members can agree the concern should not be included.
 - 2) Poll team members, if two thirds agree with the concern it should be included.
- 3) The team leader should decide in cases of split opinions.**
- 4) Poll team members, majority rules and the team leader breaks ties.
- n. Who is responsible for reporting the results of the evaluation to contractor facility management and Department management? (K&S 1.18-1.h)
The team leader.
- o. Who should attend the assessment out-brief (exit meeting)? (K&S 1.18-1.h)
- DOE Facility Representative
 - all assessment team members
 - contractor management
- i. You are assigned as an assessor and are to report the results to Management, describe the three (3) main parts of the presentation and the areas addressed in each of the areas. (K&S 1.18-1.h)
- 1) Introduction - provides the audience with the purpose and direction of the presentation.
 - Subject and purpose
 - Expected duration
 - Briefly describe major areas to be covered
 - Explanation of how questions will be handled.
 - 2) Body of the presentation - provides all the information that needs to be comprehended. The following information should be presented for each area to be evaluated.
 - Criteria or requirement
 - Conditions
 - Problems or conclusions
 - Recommendations or commitments
 - 3) Conclusion - A short summarization of major ideas or points.

- p. In accordance with Operations Assessments (DOE-EM-STD-5505-96), discuss the information exchange occurring at the Assessment Out-briefing. (K&S 1.18-1.h)
- The team leader should prepare and present opening remarks followed by a clear presentation of all concerns developed by the team. Questions from the activity management on specifics of the concerns should be encouraged by the team leader. Team members most knowledgeable in the findings that support individual concerns should be prepared to assist the team leader in answering questions when needed.
- q. Perform follow-up activities as applicable to ensure implementation of corrective actions, including tracking and close-out. (K&S 1.18-1.i)
- Follow-up on the effectiveness of corrective actions for deficient conditions should be scheduled as part of the management monitoring program. Follow-up monitoring should determine if the immediate condition has been corrected and the root cause(s) eliminated. In some cases, this will require monitoring of the immediate corrective actions and subsequent monitoring of determine whether recurrence of the condition is minimized. For the latter, sufficient time will be need to be allowed to permit the completion of all corrective actions. Based on the results of the follow-up monitoring, the item can be closed or new corrective actions formulated.
- r. In accordance with Operations Assessments (DOE-EM-STD-5505-96), the assessment results can be used by Field Element managers as a factor in determining contractor monetary incentives. What three (3) items should the Field Element manager consider when determining the incentives? (K&S 1.18-1.i)
- severity of the concerns
 - completion of corrective actions
 - overall contractor progress

Competency 1.19

Facility maintenance management (FAC# 2.4) personnel shall demonstrate a familiarity level knowledge of the following maintenance management-related Department of Energy Technical Standards:

- DOE-STD-1050-93, Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities
- DOE-STD-1051-93, Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities
- DOE-STD-1052-93, Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities
- DOE-STD-1053-93, Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities
- DOE-STD-1054-93, Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities
- DOE-STD-1055-93, Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities
- DOE-STD-1064-94, Guideline to Good Practices for Seasonal Facility Preservation at DOE Nuclear Facilities
- DOE-STD-1065-94, Guideline to Good Practices for Post Maintenance Testing at DOE Nuclear Facilities
- DOE-STD-1067-94, Guideline to Good Practices for Maintenance Facilities, Equipment, and Tools at DOE Nuclear Facilities
- DOE-STD-1069-94, Guideline to Good Practices for Maintenance Tools and Equipment Control at DOE Nuclear Facilities
- DOE-STD-1071-94, Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities
- DOE-STD-1072-94, Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities

1. Supporting Knowledge and/or Skills

- a. Describe the purpose, scope, and application of the requirements detailed in the Technical Standards listed above.
- b. Discuss the impact and/or relationship of the above referenced Technical Standards to the facility maintenance management functional area.

2. Self-Study Information

Competency 1.19 addresses maintenance management-related Department of Energy Technical Standards. Competency 1.19 is at a familiarity level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities, DOE-STD-1050-93
- Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities, DOE-STD-1051-93
- Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities, DOE-STD-1052-93
- Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities, DOE-STD-1053-93
- Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities, DOE-STD-1054-93
- Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities, DOE-STD-1055-93
- Guideline to Good Practices for Seasonal Facility Preservation at DOE Nuclear Facilities, DOE-STD-1064-94
- Guideline to Good Practices for Post Maintenance Testing at DOE Nuclear Facilities, DOE-STD-1065-94
- Guideline to Good Practices for Maintenance Facilities, Equipment, and Tools at DOE Nuclear Facilities, DOE-STD-1067-94
- Guideline to Good Practices for Maintenance Tools and Equipment Control at DOE Nuclear Facilities, DOE-STD-1069-94
- Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities, DOE-STD-1071-94
- Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities, DOE-STD-1072-94

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

a. For Supporting Knowledge and Skills **1.19-1.a** refer to:

- Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities, DOE-STD-1050-93.
- Guideline to Good Practices for Maintenance Organization and Administration at

- DOE Nuclear Facilities, DOE-STD-1051-93.
- Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities, DOE-STD-1052-93.
 - Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities, DOE-STD-1053-93.
 - Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities, DOE-STD-1054-93.
 - Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities, DOE-STD-1055-93.
 - Guideline to Good Practices for Seasonal Facility Preservation at DOE Nuclear Facilities, DOE-STD-1064-94.
 - Guideline to Good Practices for Post Maintenance Testing at DOE Nuclear Facilities, DOE-STD-1065-94.
 - Guideline to Good Practices for Maintenance Facilities, Equipment, and Tools at DOE Nuclear Facilities, DOE-STD-1067-94.
 - Guideline to Good Practices for Maintenance Tools and Equipment Control at DOE Nuclear Facilities, DOE-STD-1069-94.
 - Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities, DOE-STD-1071-94.
 - Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities, DOE-STD-1072-94.

A statement of Purpose, Scope, and Application for each of the Standards identified in Section 2 above may be located in the first few pages of each document. As a matter of format, Purpose will be found under Section 1.1, Application under Section 1.3 and Scope under Section 3.2.

b. For Supporting Knowledge and Skills **1.19-1.b** refer to:

Each of the Standards identified in Section 2 addresses a specific functional area within the Maintenance Management Program. These Standards are to serve as an example of how to implement the requirements of DOE Order 4330.4B. Facilities should use each Standard as a guide for the assessment, development, or enhancement of the corresponding Maintenance Management Program functional area. Since these Standards are intended to be used as guidelines and not to be interpreted as regulatory requirements, the application of a "graded approach" in their implementation is appropriate. The only exception to this rule is when a DOE Standard is invoked by a DOE Order (e.g., DOE Order 5480.26 invokes DOE Standard 1048-92). In these cases specific implementing guidance is provided in the Standard or Order.

The purposes of the following documents are found in the forwards of each document and in Section 1.1 of the Introduction.

DOE-STD-1050-93

Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities

To provide contractor maintenance organizations with information that may be used for development and implementation of a rigorously controlled maintenance program directed at planning, scheduling, and coordinating work packages for maintenance tasks at DOE nuclear facilities.

DOE-STD-1051-93

Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities

To provide contractor maintenance organizations with information that may be used to verify adequacy of and/or modify existing maintenance organization programs or to develop new programs.

The guide describes key features of programs that support maintenance organization and administration. Their implementation should enhance safe, reliable, and efficient maintenance operations. Included in these key features is guidance for the following organizational and administrative functions:

- management of resources, qualifications, skill levels, and staffing
- human resource awareness, education and training to ensure clear understanding of requirements (administrative, operational, and technical)
- maintenance management for oversight and monitoring of maintenance activities and to determine root causes for undesirable conditions
- document control for clear definition of requirements and configuration management of information used in the performance of maintenance activities.

DOE-STD-1052-93

Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities

This guide is intended to assist facility maintenance operations in the review of existing and in developing new corrective, preventive, and predictive maintenance programs.

DOE-STD-1053-93

Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities

To provide contractor maintenance organizations with information that may be used for development and implementation of a rigorously controlled maintenance program directed at achieving high quality work performance, personnel safety, radiological protection, operating equipment/system protection, and overall site safety and reliability at DOE nuclear facilities.

The guide is intended to assist facility maintenance operations in the review of existing and developing new programs to ensure maintenance practices provide an administrative method by which maintenance activities are identified, initiated, planned, approved, scheduled, coordinated, performed, and reviewed for adequacy and completeness.

DOE-STD-1054-93

Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities

To provide contractor maintenance organizations with information that may be used for development and implementation of a rigorously controlled maintenance program directed at controlling and calibrating M&TE used for maintenance tasks at DOE nuclear facilities. The accuracy and integrity of performance data derived from Plant process and control instrumentation is verified by controlled application of properly calibrated/certified measuring and test equipment (M&TE) having the appropriate precision, design accuracy, and durability for their intended use.

DOE-STD-1055-93

Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities

To provide contractor maintenance organizations with information that may be used to verify adequacy of and/or modify existing maintenance management programs, or to develop new programs.

This guide describes key features of programs that support maintenance management. Their implementation should enhance safe, reliable, and efficient maintenance operations. Included in these key features is guidance for the following management functions:

- management involvement
- performance indicators, goals, and objective results

- problem analysis
- feedback
- program reviews

DOE-STD-1064-94

Guideline to Good Practices for Seasonal Facility Preservation at DOE Nuclear Facilities

This guide is intended to assist facility maintenance organizations in the review of existing methods and in the development of new methods for establishing a maintenance Seasonal Facility Preservation program. It provides contractor maintenance organizations with information which may be used for the development and implementation of a seasonal facility preservation plan developed for maintenance organizations at Department of Energy nuclear facilities

DOE-STD-1065-94

Guideline to Good Practices for Post Maintenance Testing at DOE Nuclear Facilities

To provide contractor maintenance organizations with information that may be used for development and implementation of a post maintenance testing (PMT) process for structures, systems, and components (SSC) at DOE nuclear facilities.

This guide is intended to assist facility maintenance operations in the review of existing and in developing new post maintenance testing (PMT) guidelines to be performed following maintenance. The post maintenance testing (PMT) is designed to prove that structures, systems, and components (SSC) are operable as designed and confirms the following:

- (1) the original deficiency has been corrected,
- (2) no new deficiencies have been created, and
- (3) the equipment is ready to return to service.

DOE-STD-1067-94

Guideline to Good Practices for Maintenance Facilities, Equipment, and Tools at DOE Nuclear Facilities

To provide contractor maintenance organizations with information that may be used for development and implementation of a rigorously controlled evaluation process for maintenance facilities, equipment, and tools used in the performance of maintenance tasks at DOE nuclear facilities.

This guide is intended to assist facility maintenance organizations in the review of existing methods and in the development of new methods for evaluating maintenance facilities, equipment, and tools. Properly established maintenance facilities:

- (1) support As Low As Reasonably Achievable (ALARA) goals,
- (2) enhance user accessibility, and
- (3) encourage selection and use of the proper item for a safe, effective, first effort.

DOE-STD-1069-94

Guideline to Good Practices for Maintenance Tools and Equipment Control at DOE Nuclear Facilities

To provide contractor maintenance organizations with information that may be used for development and implementation of a rigorously controlled maintenance program directed at establishing maintenance tools and equipment control at DOE nuclear facilities.

This guide is intended to assist facility maintenance organizations in the review of existing methods and in the development of new methods for evaluating maintenance tool and equipment control for all areas of the facility, including radiologically controlled areas (RCAs). Tools and equipment of the proper type, quality, and quantity should be available for issue and use when needed by the maintenance craftspersons. Adequate tool and equipment control in the facility contributes to worker efficiency, and it also is needed to limit the number of tools introduced into potentially contaminated areas, to minimize the spread of radioactive contamination, and to reduce volumes of solid radioactive wastes. A dedicated supply of tools and equipment should be established for exclusive use within the facilities RCAs. A controlled supply of tools and equipment should be provided to ensure that an adequate quantity is available to avoid delays in maintenance work activities. Good tool control should minimize the risks of

- (1) personnel contaminations and
- (2) the inadvertent release to radiologically uncontrolled areas of such potentially contaminated items. Personnel accountability is essential to an effective tool and equipment control program.

An adequate decontamination facility is needed to enable the facility to reuse a wide variety of contaminated tools and equipment and to minimize replacement expenditures. A versatile decontamination facility and program should be used to reduce levels of removable and fixed radioactive contamination on the surface of controlled tools and equipment. Decontamination of tools and equipment also should be used to minimize the contribution of contaminated tools and equipment to solid radioactive waste volumes.

DOE-STD-1071-94

Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities

To provide contractor maintenance organizations with information that may be used for development and implementation of a rigorously controlled material receipt inspection process for maintenance organizations at DOE nuclear facilities.

This guide is intended to assist facility maintenance organizations in the review of existing methods and in the development of new methods for establishing a material receipt, inspection, handling, storage, retrieval, and issuance process/system which ensures timely delivery of the proper parts and materials, in the condition required for effective maintenance activities, and periodic services which provide unique and/or supplemental maintenance support.

DOE-STD-1072-94

Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities

To provide contractor maintenance organizations with information that may be used to verify adequacy of and/or modify existing or develop new maintenance programs for performing periodic facility condition inspections.

The guide is intended to provide a means for owner/operators to have an awareness of the way business is actually being conducted on the shop floor. Also, this guide is intended to provide a means for maintenance managers to impart their expectations to craftpersons as to how maintenance should be conducted.

This guide describes key features of programs that support maintenance facility inspection. The implementation of this program should accomplish the following:

- documentation of material conditions in a consistent manner
- material deficiencies may be effectively identified for corrective actions
- support continued safe, reliable, and efficient facility maintenance operations.

This guide also assigns responsibility to all facility personnel to be alert for and identify material deficiencies. Further, it describes the method by which these deficiencies are clearly marked and translated to the work control system. This deficiency identification system serves the following functions:

- to notify other facility personnel that a deficiency has been identified and that the necessary documentation has been submitted to initiate corrective action
- to alert operational personnel to inaccuracies in facility instrumentation or degraded conditions of facility equipment and components
- to enhance facility status monitoring, maintenance planning, and facility material

condition

- to eliminate multiple submissions of maintenance job requests on the same deficiency.

The applicability of the above documents is found in Section 1.3 of each document. The statement is similar to the following:

The content of this guide is generally available to all DOE facilities. Portions of the program outlined may not be applicable to all facilities because maintenance organizations, disciplines, titles, and responsibilities may vary among DOE nuclear facilities. Facility maintenance personnel should verify the adequacy or improve existing maintenance program by adapting this guide to their specific facility and individual maintenance disciplines.

4. Practice Exercise

- a. Match the purposes in column A with the DOE Standard in column B. Use the column B answers one time only. Ignore any response in column B not identified in column A. (K&S 1.19-1.a)

Column A	Column B
___ 1. This guide describes a key feature regarding performance indicators, goals, and objective results.	a. <u>Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities</u> , DOE-STD-1050-93
___ 2. This guide addresses coordinating work packages for maintenance tasks at DOE nuclear facilities.	b. <u>Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities</u> , DOE-STD-1051-93
___ 3. The guide describes a key feature regarding the management of resources, qualifications, skill levels, and staffing.	c. <u>Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities</u> , DOE-STD-1052-93
___ 4. This guide addresses how maintenance activities are identified, initiated, planned, approved, scheduled, coordinated, performed, and reviewed for adequacy and completeness.	d. <u>Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities</u> , DOE-STD-1053-93
	e. <u>Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities</u> , DOE-STD-1054-93
	f. <u>Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities</u> , DOE-STD-1055-93

Chapter Technical Standards

- b. Match the purposes in column A with the DOE Standard in column B. Use the column B answers one time only. Ignore any response in column B not identified in column A. (K&S 1.19-1.a)

Column A	Column B
___ 1. This guide addresses adequate tool and equipment control in the facility to contribute to worker efficiency.	a. <u>Guideline to Good Practices for Seasonal Facility Preservation at DOE Nuclear Facilities</u> , DOE-STD-1064-94
___ 2. This guide ensures timely delivery of the proper parts and materials, in the condition required for effective maintenance activities, and periodic services which provide unique and/or supplemental maintenance support.	b. <u>Guideline to Good Practices for Post Maintenance Testing at DOE Nuclear Facilities</u> , DOE-STD-1065-94
___ 3. This guide assigns responsibility to all facility personnel to be alert for and identify material deficiencies.	c. <u>Guideline to Good Practices for Maintenance Facilities, Equipment, and Tools at DOE Nuclear Facilities</u> , DOE-STD-1067-94
___ 4. This guide assist to prove that structures, systems, and components (SSC) are operable as designed and confirms the following: (1) the original deficiency has been corrected, (2) no new deficiencies have been created, and (3) the equipment is ready to return to service.	d. <u>Guideline to Good Practices for Maintenance Tools and Equipment Control at DOE Nuclear Facilities</u> , DOE-STD-1069-94
	e. <u>Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities</u> , DOE-STD-1071-94
	f. <u>Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities</u> , DOE-STD-1072-94
c. State the purpose of Technical Standard DOE-STD-1050-93, <u>Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities</u> . (K&S 1.19-1.a)	

- d. Although there are no DOE Standards that directly apply to the Non-nuclear Maintenance Management Program Elements identified below, which Standards for use at DOE Nuclear Facilities can be applied using the graded approach to the elements below. (K&S 1.19-1.b)

Non-nuclear Facilities	
Maintenance Management Program Element	DOE Standard
Organization, Administration, and Training	
Condition of Facilities and Equipment	
Maintenance Documentation	no direct correlation
Work Control System	
Maintenance Facilities, Equipment, and Materials Control System	
Implementation of Maintenance Activities	no direct correlation
Maintenance Evaluation and Analysis	

- e. Identify the DOE Standard that applies to the Maintenance Management Program Element identified below. (K&S 1.19-1.b)

Nuclear Facilities	
Maintenance Management Program Element	DOE Standard
Maintenance Organization and Administration	
Training and Qualification of Maintenance Personnel	
Maintenance Facilities, Equipment and Tools	
Types of Maintenance	
Maintenance Procedures	
Planning, Scheduling, and Coordination of Maintenance	
Control of Maintenance Activities	
Post-Maintenance Testing	
Procurement of Parts, Materials, and Services	
Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance	
Control and Calibration of Measuring and Test Equipment	

Nuclear Facilities	
Maintenance Management Program Element	DOE Standard
Maintenance Tools and Equipment Control	
Facility Condition Inspection	
Management Involvement	
Maintenance History	
Analysis of Maintenance Problems	
Modification Work	
Additional Maintenance Management Requirements	

5. Practice Exercise Answers

- a. Match the purposes in column A with the DOE Standard in column B. Use the column B answers one time only. Ignore any response in column B not identified in column A. (K&S 1.19-1.a)

Column A	Column B
f 1. This guide describes a key feature regarding performance indicators, goals, and objective results.	a. <u>Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities</u> , DOE-STD-1050-93
a 2. This guide addresses coordinating work packages for maintenance tasks at DOE nuclear facilities.	b. <u>Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities</u> , DOE-STD-1051-93
b 3. The guide describes a key feature regarding the management of resources, qualifications, skill levels, and staffing.	c. <u>Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities</u> , DOE-STD-1052-93
d 4. This guide addresses how maintenance activities are identified, initiated, planned, approved, scheduled, coordinated, performed, and reviewed for adequacy and completeness.	d. <u>Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities</u> , DOE-STD-1053-93
	e. <u>Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities</u> , DOE-STD-1054-93
	f. <u>Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities</u> , DOE-STD-1055-93

Chapter Technical Standards

- b. Match the purposes in column A with the DOE Standard in column B. Use the column B answers one time only. Ignore any response in column B not identified in column A. (K&S 1.19-1.a)

Column A	Column B
d 1. This guide addresses adequate tool and equipment control in the facility to contribute to worker efficiency.	a. <u>Guideline to Good Practices for Seasonal Facility Preservation at DOE Nuclear Facilities</u> , DOE-STD-1064-94
e 2. This guide ensures timely delivery of the proper parts and materials, in the condition required for effective maintenance activities, and periodic services which provide unique and/or supplemental maintenance support.	b. <u>Guideline to Good Practices for Post Maintenance Testing at DOE Nuclear Facilities</u> , DOE-STD-1065-94
f 3. This guide assigns responsibility to all facility personnel to be alert for and identify material deficiencies.	c. <u>Guideline to Good Practices for Maintenance Facilities, Equipment, and Tools at DOE Nuclear Facilities</u> , DOE-STD-1067-94
b 4. This guide assist to prove that structures, systems, and components (SSC) are operable as designed and confirms the following: (1) the original deficiency has been corrected, (2) no new deficiencies have been created, and (3) the equipment is ready to return to service.	d. <u>Guideline to Good Practices for Maintenance Tools and Equipment Control at DOE Nuclear Facilities</u> , DOE-STD-1069-94
	e. <u>Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities</u> , DOE-STD-1071-94
	f. <u>Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities</u> , DOE-STD-1072-94
c. State the purpose of Technical Standard DOE-STD-1050-93, <u>Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities</u> . (K&S 1.19-1.a)	
To provide contractor maintenance organizations with information that may be used for development and implementation of a rigorously controlled maintenance program directed at planning, scheduling, and coordinating work packages for maintenance tasks at DOE nuclear facilities.	

Chapter Technical Standards

- d. Although there are no DOE Standards that directly apply to the Non-nuclear Maintenance Management Program Elements identified below, which Standards for use at DOE Nuclear Facilities can be applied using the graded approach to the elements below. (K&S 1.19-1.b)

Non-nuclear Facilities	
Maintenance Management Program Element	DOE Standard
Organization, Administration, and Training	DOE-STD-1051-93, <u>Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities</u>
Condition of Facilities and Equipment	DOE-STD-1072-94, <u>Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities</u>
Maintenance Documentation	no direct correlation
Work Control System	DOE-STD-1053-93, <u>Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities</u>
Maintenance Facilities, Equipment, and Materials Control System	DOE-STD-1071-94, <u>Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities</u>
Implementation of Maintenance Activities	no direct correlation
Maintenance Evaluation and Analysis	DOE-STD-1004-92, <u>Root Cause Analysis Guidance Document</u>

- e. Identify the DOE Standard that applies to the Maintenance Management Program Element identified below. (K&S 1.19-1.b)

Nuclear Facilities	
Maintenance Management Program Element	DOE Standard
Maintenance Organization and Administration	DOE-STD-1051-93, <u>Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities</u>

Nuclear Facilities	
Maintenance Management Program Element	DOE Standard
Training and Qualification of Maintenance Personnel	DOE-HDBK-1003-96, <u>Guide to Good Practices for Training and Qualification of Maintenance Personnel</u>
Maintenance Facilities, Equipment and Tools	DOE-STD-1067-94, <u>Guideline to Good Practices for Maintenance Facilities, Equipment, and Tools at DOE Nuclear Facilities</u> DOE-STD-1069-94, <u>Guideline to Good Practices for Maintenance Tools and Equipment Control at DOE Nuclear Facilities</u>
Types of Maintenance	DOE-STD-1052-93, <u>Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities</u>
Maintenance Procedures	DOE-STD-1029-92, <u>Writers Guide For Technical Procedures</u>
Planning, Scheduling, and Coordination of Maintenance	DOE-STD-1050-93, <u>Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities</u>
Control of Maintenance Activities	DOE-STD-1053-93, <u>Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities</u>
Post-Maintenance Testing	DOE-STD-1065-94, <u>Guideline To Good Practices For Post Maintenance Testing At DOE Nuclear Facilities</u>
Procurement of Parts, Materials, and Services	MNTY-0002 (11/93 Draft) <u>Guideline to Good Practices for Procurement of Parts, Materials, and Services for Nuclear Facilities</u>
Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance	DOE-STD-1071-94, <u>Guideline to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities</u>
Control and Calibration of Measuring and Test Equipment	DOE-STD-1054-93, <u>Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities</u>
Maintenance Tools and Equipment Control	DOE-STD-1069-94, <u>Guideline to Good Practices for Maintenance Tools and Equipment Control at DOE Nuclear Facilities</u>

Nuclear Facilities	
Maintenance Management Program Element	DOE Standard
Facility Condition Inspection	DOE-STD-1072-94, <u>Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities</u>
Management Involvement	DOE-STD-1055-93, <u>Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities</u>
Maintenance History	DOE-STD-1068-94, <u>Guideline To Good Practices For Maintenance History At DOE Nuclear Facilities</u>
Analysis of Maintenance Problems	DOE-STD-1004-92, <u>Root Cause Analysis Guidance Document</u>
Modification Work	DOE-STD-1073-93-Pt. 1 & 2, <u>Guide for Operational Configuration Management Program Part 1 and 2</u>
Additional Maintenance Management Requirements	DOE-STD-1064-94, <u>Guideline to Good Practices for Seasonal Facility Preservation at DOE Nuclear Facilities</u>

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Competency 1.20

Facility maintenance management (FAC# 3.2) personnel shall demonstrate a familiarity level knowledge of facility maintenance management-related data management requirements.

1. Supporting Knowledge and/or Skills

- a. Describe the local file plan and procedure and the authorized disposition requirements for facility maintenance management-related records contained in DOE Order 1324.2B, Records Disposition.
- b. Describe the reporting requirements for occurrence reports categorized as personnel safety occurrence reports per DOE Order 5000.3A, Occurrence Reporting and Processing of Operations Information, Group 3, Personnel Safety.
- c. Describe the reporting requirements outlined in DOE Order 5484.1, Environmental Protection, Safety, & Health Protection Information Reporting Requirements.
- d. Describe the requirements for documents and records contained in DOE Order 5700.6C, Quality Assurance, Criterion Four, Documents and Records.
- e. Discuss the recordkeeping requirements of DOE Order 4330.4B, Maintenance Management Program.

2. Self-Study Information

Competency 1.20 addresses facility maintenance management-related data management requirements. Competency 1.20 is at a familiarity level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Records Disposition, DOE Order 1324.2A
- Maintenance Management Program, DOE Order 4330.4B
- Occurrence Reporting and Processing of Operations Information, DOE Order 5000.3A
- Environmental Protection, Safety, & Health Protection Information Reporting Requirements, DOE Order 5484.1.
- Quality Assurance, DOE Order 5700.6C

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.20-1.a** refer to:
 - Records Disposition (DOE Order 1324.2A), Section 10.f, page 5, Chapter II, pages II-1 - II-9, Attachment V-2, pages V-17 - V-28, Attachment V-4, page V-33 and Attachment V-6, page V-39.
- b. For Supporting Knowledge and Skills **1.20-1.b** refer to:
 - Occurrence Reporting and Processing of Operations Information (DOE Order 5000.3A), Attachment I, pages 12 - 13.
- c. For Supporting Knowledge and Skills **1.20-1.c** refer to:
 - Environmental Protection, Safety and Health Protection Information Reporting Requirements (DOE Order 5484.1, Change 7), Chapter IV, pages IV-1 - IV-7.
- d. For Supporting Knowledge and Skills **1.20-1.d** refer to:
 - Quality Assurance (DOE Order 5700.6C), Attachment I, Section II.A.4, pages 6 - 8.
- e. For Supporting Knowledge and Skills **1.20-1.e** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.4.9, page I-27; Section 3.6.1.f & j, page I-36; Section 8.2, page II-44 - II-45; and Section 16, page II-84 - II-87.
 - Quality Assurance (DOE 5700.6C), Attachment I, criterion 4, page 6-8.

4. Practice Exercise

- a. In accordance with DOE Order 1324.2B, Records Disposition, when can the records concerning pump maintenance files be disposed of? (K&S 1.20-1.a)
 - 1) Destroy 1 year after the completion of maintenance
 - 2) Destroy 3 fiscal years after close of fiscal year in which work is done
 - 3) Destroy when pump removed from service
 - 4) Destroy 1 year after pump removed from service
- b. State the three (3) categories of occurrence reports in Group 3, Personnel Safety of DOE Order 5000.3A, Occurrence Reporting and Processing of Operations Information. (K&S 1.20-1.b)
 -
 -
 -
- c. Classify the following condition in accordance with DOE Order 5000.3A, Occurrence Reporting and Processing of Operations Information: (K&S 1.20-1.b)

An onsite occurrence releases trace quantities of hazardous material.

 - 1) Emergency
 - 2) Off-normal
 - 3) Site emergency
 - 4) Unusual Occurrence
- d. Where can information concerning determination of Department of Energy Property Valuation and Department of Energy Losses be found? (K&S 1.20-1.c)

Chapter V Criteria for Determining Department of Energy Property Valuation and Department of Energy Losses.
- e. DOE Order 5484.1, Environmental Protection, Safety, and Health Protection Information Reporting Requirements requires that radiation exposure exceeding certain limits per calendar quarter be reported. How and where is the report made? (K&S 1.20-1.c)

Chapter Data Management

- f. Match the body regions in column A with the exposure limits that require reporting under DOE Order 5484.1, Environmental Protection, Safety, and Health Protection Information Reporting Requirements in column B. The column B answers **MAY BE** used **MORE THAN** one time. Ignore any response in column B not identified in column A. (K&S 1.20-1.c)

Column A	Column B
___ 1. Feet of hands	a. 1.5 rem
___ 2. forearms	b. 2.5 rem
___ 3. skin of the whole body	c. 3 rem
___ 4. thyroid	d. 5 rem
___ 5. whole body	e. 7.5 rem
	f. 10 rem
	g. 25 rem

- g. Describe the requirements for documents and records contained in DOE Order 5700.6C, Quality Assurance, Criterion Four, Documents and Records. (K&S 1.20-1.d)

- h. What requirement does DOE Order 4330.4B, Maintenance Management Program, have for addressing record keeping for Maintenance History Files. (K&S 1.20-1.e)

5. Practice Exercise Answers

- a. In accordance with DOE Order 1324.2B, Records Disposition, when can the records concerning pump maintenance files be disposed of? (K&S 1.20-1.a)

- 1) Destroy 1 year after the completion of maintenance
- 2) Destroy 3 fiscal years after close of fiscal year in which work is done
- 3) Destroy when pump removed from service

4) Destroy 1 year after pump removed from service

- b. State the three (3) categories of occurrence reports in Group 3, Personnel Safety of DOE Order 5000.3A, Occurrence Reporting and Processing of Operations Information. (K&S 1.20-1.b)

- Occupational Illness/Injuries
- Vehicular/Transportation Accident
- Miscellaneous

- c. Classify the following condition in accordance with DOE Order 5000.3A, Occurrence Reporting and Processing of Operations Information: (K&S 1.20-1.b)

An onsite occurrence releases trace quantities of hazardous material.

- 1) Emergency

2) Off-normal

- 3) Site emergency

- 4) Unusual Occurrence

- d. Where can information concerning determination of Department of Energy Property Valuation and Department of Energy Losses be found? (K&S 1.20-1.c)

Chapter V Criteria for Determining Department of Energy Property Valuation and Department of Energy Losses.

- e. DOE Order 5484.1, Environmental Protection, Safety, and Health Protection Information Reporting Requirements requires that radiation exposure exceeding certain limits per calendar quarter be reported. How and where is the report made? (K&S 1.20-1.c)

By memo to the Operational and Environmental Safety Division.

- f. Match the body regions in column A with the exposure limits that require reporting under DOE Order 5484.1, Environmental Protection, Safety, and Health Protection Information Reporting Requirements in column B. The column B answers **MAY BE** used **MORE THAN** one time. Ignore any response in column B not identified in column A. (K&S 1.20-1.c)

Column A	Column B
g 1. Feet of hands	a. 1.5 rem
f 2. forearms	b. 2.5 rem
d 3. skin of the whole body	c. 3 rem
d 4. thyroid	d. 5 rem
c 5. whole body	e. 7.5 rem
	f. 10 rem
	g. 25 rem

- g. Describe the requirements for documents and records contained in DOE Order 5700.6C, Quality Assurance, Criterion Four, Documents and Records. (K&S 1.20-1.d)

Criterion Four states that "Documents shall be prepared, reviewed, approved, issued, used, and revised to prescribe processes, specify requirements, or establish design. Records shall be specified, prepared, reviewed, approved, and maintained." DOE Order 5700.6C, Attachment I, Section II.A.4 (superseded by DOE Order 5700.6C, Change 1 which removes Attachment I) provides guidance for developing a quality assurance program.

- h. What requirement does DOE Order 4330.4B, Maintenance Management Program, have for addressing record keeping for Maintenance History Files. (K&S 1.20-1.e)
- The maintenance history program should clearly define the systems and equipment to be included, what to collect, how to record data, and how the data are to be used.

Competency 1.21

Facility maintenance management (FAC# 3.3) personnel shall demonstrate a working level knowledge of contractor and Department organization and structure as they relate to maintenance management responsibilities and authority.

1. Supporting Knowledge and/or Skills

- a. Define the maintenance organizational structure.
- b. Describe the responsibilities of individuals in the organization and their authority.
- c. Describe the relationship and interface of the maintenance organization with other organizational structures.

2. Self-Study Information

Competency 1.21 addresses contractor and Department organization and structure as they relate to maintenance management responsibilities and authority. Competency 1.21 is at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities, DOE-STD-1051-93

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.21-1.a** refer to:
 - Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Section 2.3.1, page 4.
- b. For Supporting Knowledge and Skills **1.21-1.b** refer to:
 - Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Sections 2.3.1.a - 2.3.1.d, pages 4 - 6.

- c. For Supporting Knowledge and Skills **1.21-1.c** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 2.3.2.a, pages II-4 - II-5.
 - Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Section 2.3.9, page 11.

- [illegible]

- [illegible]

5. Practice Exercise Answers

- a. Define a typical maintenance organizational structure. (K&S 1.21-1.a)

A typical maintenance organization is composed of a maintenance division manager and various department with department managers. Organization charts should indicate line and staff positions and interfaces within the maintenance division and with the plant organization. Interfaces with committees, should also be shown on the organization chart. Position descriptions or equivalent procedural guidance should be used to supplement the maintenance organization chart. Position descriptions should clearly define the authorities, responsibilities, and qualifications for each management position within the maintenance organization. Additionally, procedures and policies that describe the functions and interfaces of the organization should be implemented. Measures should be established to ensure that organization charts, positions descriptions, and related procedures are maintained current.

- b. Obtain a maintenance organizational chart for the facility (the one you are assigned to or are working with). Identify the personnel that fill the identified positions. (K&S 1.21-1.a)

see facility/site specific organization chart

- c. Obtain a maintenance organizational chart for the facility (the one you are assigned to or are working with). Identify the authorities, responsibilities, and qualifications for the identified positions. (K&S 1.21-1.b)

see facility/site specific organization chart and position descriptions.

- d. Describe the relationship and interface of the maintenance organization with other organizational structures. (K&S 1.21-1.c)

Maintenance personnel should clearly understand their authority, responsibility, accountability, and interfaces with other groups.

Maintenance division staff interface with many outside organizations, such as the bargaining unit, federal regulatory agencies, state regulatory agencies and commissions, local governmental bodies, industry oversight and advisory groups, and insurance companies.

Maintenance division management should not acquiesce to outside organizations to the extent that management's primary responsibility - personnel safety and plant safety and reliability - is compromised.

Chapter Organization and Structure

Each facility should develop an integrated approach to maintenance so that working relationships are developed among all organizational units that support the maintenance function (e.g., operations, health physics, stores, quality control, engineering, and procurement).

The maintenance strategy should chart the relationship among these supporting groups, as related to overall facility maintenance, by defining responsibility, authority, and accountability. This will entail identification of:

- personnel interfaces
- periodic self-assessments of work activities
- procedural interfaces
- indicators relating to support of maintenance tracked for each supporting group (e.g., number of plant work orders on hold because of lack of spare parts).

Competency 1.22

Facility maintenance management (FAC# 4.2) personnel shall demonstrate a working level knowledge of lessons learned and problems impacting the Department's maintenance activities across complex.

1. Supporting Knowledge and/or Skills

- a. Describe the documentation of the Department's and industry's "lessons learned" and current events.
- b. Discuss recent events that impact maintenance management activities.
- c. Discuss current efforts by the Department and the contractor to address issues and recent events.
- d. Discuss recent issues identified by external groups (e.g., Defense Nuclear Facilities Safety Board, Environmental Protection Agency, Occupational Safety and Health Act) and Department oversight groups (Environmental Health and Operational Readiness Reviews) that impact facility maintenance.
- e. Explain the intent of a Maintenance Problem Analysis Program and discuss a maintenance problem where this program has recently been employed.

2. Self-Study Information

Competency 1.22 addresses lessons learned and problems impacting the Department's maintenance activities across complex. Competency 1.22 is at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Development of DOE Lessons Learned Program, DOE-STD-7501-95
- Implementing DOE Lessons Learned Program, DOE-HDBK-7502-95
- Operating Experience Weekly Summaries, Office of Nuclear and Facility Safety
- Lessons Learned Programs, Safety Notice 95-03, DOE/EH-0504

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.22-1.a** refer to:
 - Development of DOE Lessons Learned Program (DOE-STD-7501-95).
 - Implementing DOE Lessons Learned Program (DOE-HDBK-7502-95).
- b. For Supporting Knowledge and Skills **1.22-1.b** refer to:
 - Operating Experience Weekly Summaries, Office of Nuclear and Facility Safety, Various Issues.
- c. For Supporting Knowledge and Skills **1.22-1.c** refer to:
 - Development of DOE Lessons Learned Program (DOE-STD-7501-95).
 - Implementing DOE Lessons Learned Program (DOE-HDBK-7502-95).
- d. For Supporting Knowledge and Skills **1.22-1.d** refer to:
 - Operating Experience Weekly Summaries, Office of Nuclear and Facility Safety, Various Issues.
- e. For Supporting Knowledge and Skills **1.22-1.e** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 17.2, page II-88.

The ability to apply lessons learned from in-house maintenance experiences (and the experiences of others) is essential for long term success. Management should use information about problems encountered during maintenance activities to improve performance. Maintenance can also benefit by taking advantage of related experience at other facilities.

Review of Weekly Summary and synopsis documents should not be a substitute for a thorough review of the interim and final occurrence reports.

4. Practice Exercise

a. What is the objective of the DOE Lessons Learned Program? (K&S 1.22-1.a)

b. List ten (10) sources of lessons learned information. (K&S 1.22-1.a)

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-
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-
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-
-
-

c. What are the five (5) main functional categories (names and series number) contained in the DOE Lessons Learned Information System template? (K&S 1.22-1.a)

- series
- series
- series
- series
- series

Chapter Lessons Learned

- d. What are the four (4) Priority Descriptor (name and colour code) contained in the DOE Lessons Learned Information System template? (K&S 1.22-1.a)
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- e. What actions are required concerning the actions performed for a Red/Urgent Priority Descriptor of the DOE Lessons Learned Information System? (K&S 1.22-1.a)
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 -
- f. What program is used for dissemination of technical information regarding operating experience? (K&S 1.22-1.c)
- g. List three (3) ways that Lessons Learned Information can be provided. (K&S 1.22-1.c)
 -
 -
 -
- h. What is the purpose of the Maintenance Problem Analysis Program ? (K&S 1.22-1.e)
- i. As part of an exercise for this section, review documentation, provided by your supervisor, of recent maintenance management activity events. Based on this review, develop and discuss recommendations and applications of the results with your supervisor. (K&S 1.22-1.b)
- j. As part of an exercise for this section, review documentation of recent issues identified by external groups and Department oversight groups that impact facility maintenance. Based on this review, develop and discuss recommendations and applications of the results with your supervisor. (K&S 1.22-1.d)

Chapter Lessons Learned

- k. As part of an exercise for this section, review a maintenance problem that has been investigated under the Maintenance Problem Analysis Program. Discuss the findings and recommended corrective actions, where applicable, with your supervisor.

5. Practice Exercise Answers

- a. What is the objective of the DOE Lessons Learned Program? (K&S 1.22-1.a)
To provide a means of communicating experiences which can potentially reduce risk, improve efficiency, and enhance the cost effectiveness of DOE processes and operations.

- b. List ten (10) sources of lessons learned information. (K&S 1.22-1.a)
Any ten of the following (or equivalent)

From DOE-STD-7501-95	From DOE-HDBK-7502-95
<ul style="list-style-type: none"> Lessons Learned Information System (DOELLIS) Safety Notices Operational Experience Weekly Reports Environmental, Safety, and Health Bulletins Occurrence Reporting and Processing System Assessments Audits Appraisals Accidents/Incident Investigation Reports Technology Information Exchange (TIE) Quarterly Occupational Safety Observer The Safety Connection Packaging and Transportation Safety Weekly Report Packaging and Transportation Safety Lessons Learned Bulletins Safety Performance Monitoring System 	<ul style="list-style-type: none"> Daily activities and experiences Occurrence and incident reports Assessment activities Operational Readiness Reviews Management reviews Performance or process improvement initiatives Government or industry experiences Technical periodicals and bulletins Project completion evaluations

- c. What are the five (5) main functional categories (names and series number) contained in the DOE Lessons Learned Information System template? (K&S 1.22-1.a)
- Leadership/Planning - 100 series
 - Information and Analysis - 200 series
 - Human Resources - 300 series
 - Work Process - 400 series
 - Business and Support Services - 500 series

- d. What are the four (4) Priority Descriptor (name and colour code) contained in the DOE Lessons Learned Information System template? (K&S 1.22-1.a)
- Red/Urgent
 - Yellow/Caution
 - Blue/Information
 - Green/Good Work Practices
- e. What actions are required concerning the actions performed for a Red/Urgent Priority Descriptor of the DOE Lessons Learned Information System? (K&S 1.22-1.a)
- Timely dissemination,
 - review,
 - documentation, and
 - tracking of actions performed.
- f. What program is used for dissemination of technical information regarding operating experience? (K&S 1.22-1.c)
- Lessons Learned Program
- g. List three (3) ways that Lessons Learned Information can be provided. (K&S 1.22-1.c)
- Formal training
 - Shift briefings
 - Required reading
- h. What is the purpose of the Maintenance Problem Analysis Program ? (K&S 1.22-1.e)
- The Maintenance Problem Analysis Program is established to investigate unplanned occurrences that have an impact on safety or reliability or that are of a recurring nature.
- i. As part of an exercise for this section, review documentation, provided by your supervisor, of recent maintenance management activity events. Based on this review, develop and discuss recommendations and applications of the results with your supervisor. (K&S 1.22-1.b)
- j. As part of an exercise for this section, review documentation of recent issues identified by external groups and Department oversight groups that impact facility maintenance. Based on this review, develop and discuss recommendations and applications of the results with your supervisor. (K&S 1.22-1.d)

Chapter Lessons Learned

- k. As part of an exercise for this section, review a maintenance problem that has been investigated under the Maintenance Problem Analysis Program. Discuss the findings and recommended corrective actions, where applicable, with your supervisor.

Competency 1.23

Facility maintenance management (FAC# 4.3) and EH Residents (FAC# 2.16) personnel shall demonstrate a working level knowledge of the requirements of a maintenance management program.

1. Supporting Knowledge and/or Skills
 - a. Describe the structures, systems, and components included in a maintenance management program.
 - b. Discuss line management's responsibilities for the maintenance management program.
 - c. Define the term "graded approach" and discuss its application to a maintenance management program.
 - d. Discuss the application of Technical Safety Requirements in a maintenance management program.
 - e. Discuss the management systems that control maintenance activities.
 - f. Describe the mechanisms for feedback of information (such as trend analysis and instrumentation performance/reliability data) to identify necessary program modifications.
 - g. Discuss the role of configuration management as it relates to maintenance management.

2. Self-Study Information

Competency 1.23 addresses requirements of a maintenance management program.
Competency 1.23 is at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Technical Safety Requirements, DOE Order 5480.22
- Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities, DOE-STD-1051-93
- Guideline to Good Practices for Types of Maintenance Activities at DOE Nuclear Facilities, DOE-STD-1052-93
- Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities, DOE-STD-1053-93
- Guide for Operational Configuration Management Program, DOE-STD-1073-93-Pt. 1

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.23-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 7.a - c, page 3 and Section 5.3.1, page II-21.
 - Guideline to Good Practices for Types of Maintenance Activities at DOE Nuclear Facilities (DOE-STD-1052-93), Section 3.4.1, page 10.
- b. For Supporting Knowledge and Skills **1.23-1.b** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 7.d, page 4 and Section 8.i, page 4 and Sections 2.3.1 - 2.3.5, pages II-4 - II-8.
 - Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Section 2.3.1, pages 4 - 6.
 - Guideline to Good Practices for Types of Maintenance Activities at DOE Nuclear Facilities (DOE-STD-1052-93), Section 3.3, pages 8 - 9.

- c. For Supporting Knowledge and Skills **1.23-1.c** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 1, pages I-1 - I-3; Section 8.i, page 4; Section 10.d, page 10; Attachment 1 item 4, page 1 - 2; Section 1, page I-3; and Section 1, page II-2.
 - Guide for Operational Configuration Management Program (DOE-STD-1073-93-Pt.1), Section 1.4, pages I-14 - I-25.
 - Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports (DOE-STD-1027-92), Section 4.0, pages 9 - 11 and Attachment 1, pages A-1 - A-5.
 - Establishing and Maintaining a Facility Representative Program at DOE Nuclear Facilities (DOE-STD-1063-93), Section 5.1, pages 10 - 11.
- d. For Supporting Knowledge and Skills **1.23-1.d** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Sections 3.4 and 3.4.1, page I-17 - I-19; Sections 5.1 and 5.2, pages II-18 - II-20; and Section 8.3.2, page II-47.
 - Technical Safety Requirements, (DOE Order 5480.22).
- e. For Supporting Knowledge and Skills **1.23-1.e** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 8.2, pages II-44 - II-46.
 - Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities (DOE-STD-1053-93), Appendix A, page A-3.
- f. For Supporting Knowledge and Skills **1.23-1.f** refer to:
- Guideline to Good Practices for Types of Maintenance Activities at DOE Nuclear Facilities (DOE-STD-1052-93), Sections 3.4.3.6 and 3.4.4.7, pages 12 and 19 - 20.
- g. For Supporting Knowledge and Skills **1.23-1.g** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 8.2 page II-46; Section 16.2, page II-84 - II-85; and Section 18.3.1, page II-95.
 - Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Section 4.3.4, pages 26 - 28.
 - Guide for Operational Configuration Management Program (DOE-STD-1073-93-Pt. 1), Appendix I-A, pages I-A-2 - I-A-3.

4. Practice Exercise

- a. Describe the structures, systems, and components included in a maintenance management program. (K&S 1.23-1.a)
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- b. Discuss line management's responsibilities for the maintenance management program. (K&S 1.23-1.b)
- c. What is the purpose of applying a "graded approach" to a maintenance management program. (K&S 1.23-1.c)
- d. Define the term "graded approach" and discuss its application to a maintenance management program. (K&S 1.23-1.c)

- e. Which documents can be referenced to assist in determination of the hazard levels at nuclear facilities to determine the level of analysis, documentation, and action required under the graded approach? (K&S 1.23-1.c)
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- f. According to DOE-STD-1073-93-Pt.1, the graded approach for the Configuration Management program is based on hazard. What is the hazard based on? (K&S 1.23-1.c)
- g. Discuss the application of Technical Safety Requirements in a maintenance management program. (K&S 1.23-1.d)

- h. Discuss the management systems that control maintenance activities. (K&S 1.23-1.e)

- i. Based on relevant information, such as trend analysis and instrumentation performance/reliability data, what actions can be taken to modify and improve the predictive maintenance program. (K&S 1.23-1.f)
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- j. Discuss the role of configuration management as it relates to maintenance management. (K&S 1.23-1.g)
- k. In accordance with (DOE-STD-1051-93), a clearly defined maintenance policy regarding Configuration Management should be clearly defined and communicated. What information should be contained in the policy? (K&S 1.23-1.g)
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5. Practice Exercise Answers

- a. Describe the structures, systems, and components included in a maintenance management program. (K&S 1.23-1.a)
- The maintenance management program for all DOE property be consistent with this order and that all DOE property be maintained in a manner which promotes operational safety, worker health, environmental protection and compliance, property preservation, and cost-effectiveness while meeting the programmatic mission.
 - Structures, systems, and components that are important to safe operation shall be subject to a maintenance program in order to meet or exceed their design requirements throughout their life.
 - Periodic inspection of structures, systems, components, and equipment be performed to determine deterioration or technical obsolescence which threaten performance and/or safety.
- b. Discuss line management's responsibilities for the maintenance management program. (K&S 1.23-1.b)
- Primary responsibility, authority, and accountability for the direction and management of the maintenance programs for all property reside with the line management assigned direct programmatic responsibility.
- c. What is the purpose of applying a "graded approach" to a maintenance management program. (K&S 1.23-1.c)
- DOE facilities are so diverse in character and age--many have been operating for several decades--that it is impossible to develop a single set of program criteria directly applicable to them all. However a wide variety of facilities can be accommodated by means of the graded approach to adapt DOE general criteria. Use of the graded approach also makes it easier to apply resources where the greatest benefit can be realized.
- d. Define the term "graded approach" and discuss its application to a maintenance management program. (K&S 1.23-1.c)
- The level of analysis, documentation, and actions necessary to comply with a requirement in the Order are commensurate with:
- The relative importance to safety, safeguards, and security
 - The magnitude of any hazard involved
 - The stage of the facility's life cycle
 - The programmatic mission of the facility
 - The particular characteristics of the facility, and
 - Any other relevant factor.

- e. Which documents can be referenced to assist in determination of the hazard levels at nuclear facilities to determine the level of analysis, documentation, and action required under the graded approach? (K&S 1.23-1.c)
- DOE-5480.23 Nuclear Safety Analysis Reports
 - DOE-STD-1027-93 Hazard Categorization and Accident Analysis Techniques for Compliance with DOE-5480.23 Nuclear Safety Analysis Reports
- f. According to DOE-STD-1073-93-Pt.1, the graded approach for the Configuration Management program is based on hazard. What is the hazard based on? (K&S 1.23-1.c)
- Hazard is related to the worst possible accident without regard for either the physical SSCs or the administrative programs intended to prevent, detect, or mitigate potential accidents.
- g. Discuss the application of Technical Safety Requirements in a maintenance management program. (K&S 1.23-1.d)
- DOE Order 4330.4B cites DOE Order 5480.22, Technical Safety Requirements, which delineates the criteria, content, scope, format, approval process, and reporting requirements of Technical Safety Requirements (TSRs) or revisions thereof.

The requirements of 4330.4B state that "The structures, systems, and components included, using a graded approach and the requirements derived from Technical Safety Requirements." Although, Technical Safety Requirements surveillance and in-service inspection requirements are not address in DOE 4330.4B because they involve facility specific situations requiring unique directions, they should be considered in the Maintenance Program development. However, use of these guidelines should support and complement performance in those activities. The Order goes on to say that "operations maintenance surveillance, inspections, and in-service inspections should be considered as essential source data in establishing the scope of the predictive and preventive maintenance program."

h. Discuss the management systems that control maintenance activities. (K&S 1.23-1.e)

Managers should be sufficiently involved with facility operations to be technically informed and personally familiar with the conditions at the operating facility to ensure the safety of DOE nuclear facility operations.

Managers should visit the facility, including visits at irregular hours, assess selected activities and portions of the facility, and leave a written record of their observations.

Managers should periodically review the maintenance program to verify that they are effectively accomplishing the intended objectives and the programs are upgraded as needed.

Facility managers and supervisors should review the work of non-facility contractor and sub-contractor personnel during preparation for work, at the job site, and during post maintenance testing and acceptance inspections to extent needed to enforce these requirements.

Examples of work practices that should be reviewed and verified include the following:

- safety is the first priority for all work, ensure unsafe conditions and deficiencies are clearly identified
 - industrial safety and radiological protection practices
 - exposure of personnel to hazardous materials and conditions is minimized
 - the potential for the spread of radioactive or other hazardous materials is minimized through proper containment and handling
 - proper use of pre-job briefings and applicable training
 - quality of workmanship, materials, and parts
 - work being performed on the correct structures, systems, and components (SSC)
 - applicable authorization, procedures, documents, permits are available at the job site
 - individuals performing work or responsible for work are adequately trained and have a clear understanding of work scope and the effect of the work being performed
 - the purpose and importance of plant structures, systems, and components (SSC)
 - general facility layout (including emergency egress routes and assembly locations)
 - maintenance activities are under the control of the applicable owner/operator
 - maintenance personnel exhibit an attitude of first-effort quality workmanship
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- the concept of ALARA includes "value-added" considerations when planning work to minimize potential exposure
 - maintenance personnel are:
 - attentive to identifying deficiencies and off-normal conditions and bringing

- them to the attention of applicable managers
- responsive to priority correction of deficiencies and off-normal conditions when approved by applicable managers
- environmental protection/regulations
- proper handling and storage of hazardous materials and waste minimization
- procedure use, including adherence to step-by-step requirements, sign-offs, and work hold points
- open system and component protection (foreign material exclusion)
- accountability of tools, chemicals, and materials
- use of proper tools for the proper job
- work progress and time required to perform the job, especially in a Limiting Condition for Operation exists
- operations and support organizations involvement is coordinated into applicable activities
- effective trouble shooting techniques
- by-passing or deactivation of safety controls, interlocks, and plant structures, systems, or components (SSC) for test purposes, calibration/certification, or maintenance is performed in accordance with detailed, approved procedures and permits
- the requirements and conditions for restoring plant structures, systems, and components (SSC) to service following deactivation or by-passing is documented and verified
- post maintenance testing instructions should be clearly defined, understood, and include the following:
 - clearly written instructions
 - specific parameter acceptance criteria
 - applicable test precautions and safety considerations
 - a test scope adequate to verify the adequacy of completed work
 - documentation of test results/data
 - test results review and written acceptance by operations
- proper use of post-job reporting and when applicable post-job critiques
- backlog is effectively managed

- i. Based on relevant information, such as trend analysis and instrumentation performance/reliability data, what actions can be taken to modify and improve the predictive maintenance program. (K&S 1.23-1.f)
- adding or deleting equipment from the program
 - adding or deleting predictive maintenance activities on a particular piece of equipment
 - identifying the need for new, upgraded, or additional monitoring equipment and software
 - proposing plant design changes
 - adjusting task intervals

- j. Discuss the role of configuration management as it relates to maintenance management. (K&S 1.23-1.g)

Configuration control is maintained by ensuring that system and equipment are restored to their original condition following maintenance.

A modification is a planned and controlled change to a permanent facility structure, system, or equipment that is accomplished in accordance with the requirements and limitations of applicable procedures, codes, standards, specifications, licenses, and predetermined safety restrictions identical to or commensurate with those of the item being modified.

Facility maintenance personnel should be cognizant of the effects of modifications prior to maintaining modified structures, systems, and equipment. The required changes to such documents as drawings, procedures, spare parts lists, and vendor information should be accomplished prior to operation of system or equipment and subsequent maintenance activities.

- k. In accordance with (DOE-STD-1051-93), a clearly defined maintenance policy regarding Configuration Management should be clearly defined and communicated. What information should be contained in the policy? (K&S 1.23-1.g)
- scope of configuration management control
 - responsibilities of the maintenance organization
 - principal interfaces between the plant and maintenance organization that directly control material condition assessments and plant design base requirements
 - identification of each maintenance line manager's responsibility for implementing the necessary controls to ensure effective implementation of the configuration management policy.

Competency 1.24

Facility maintenance management (FAC# 4.7) personnel shall demonstrate the ability to trend facility maintenance management-related data.

1. Supporting Knowledge and/or Skills

- a. Discuss the key processes used in the trending and analysis of operations information and its relationship to facility maintenance management activities.
- b. Discuss the importance and key items of a maintenance history.
- c. Given appropriate data, demonstrate the ability to analyze the data.
- d. Given DOE Order 5480.26, Trending and Analysis of Operations Information Using Performance Indicators, discuss the key elements of the Order and how they are applied.
- e. Given incident/occurrence report data for a specified period, analyze the information for safety trends or compliance problems.

2. Self-Study Information

Competency 1.24 addresses trending facility maintenance management-related data.
Competency 1.24 is at a demonstrate the ability level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Trending and Analysis of Operations Information Using Performance Indicators, DOE Order 5480.26
- Quality Assurance, DOE Order 5700.6C
- Root Cause Analysis Guidance Document, DOE-STD-1004-92
- DOE Performance Indicators Guidance Document, DOE-STD-1048-92
- Guideline To Good Practice For Maintenance Organization and Administration At DOE Nuclear Facilities, DOE-STD-1051-93
- Guideline To Good Practices For Maintenance History At DOE Nuclear Facilities, DOE-STD-1068-94
- Decision Analysis Techniques, Safety Notice 95-01, DOE/EH-0500
- Problem Analysis and Risk Assessment Topical Area Self Study Guide

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.24-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 17.3.1 and 17.3.3, pages II-91 - II-93.
- b. For Supporting Knowledge and Skills **1.24-1.b** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Sections 16.1 and 16.2, pages II-84 - II-85.
 - Guideline To Good Practices For Maintenance History At DOE Nuclear Facilities (DOE-STD-1068-94), Sections 3.1 and 3.2, page 4.
- c. For Supporting Knowledge and Skills **1.24-1.c** and **1.24-1.e** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Sections 17.3.2 and 17.3.3, pages II-89 - II-93.
 - Root Cause Analysis Guidance Document (DOE-STD-1004-92).
 - DOE Performance Indicators Guidance Document (DOE-STD-1048-92), Appendix 5, pages A5-1 - A5-6.
 - Guideline To Good Practice For Maintenance Organization and Administration At DOE Nuclear Facilities (DOE-STD-1051-93), Section 4.3.3, pages 25 - 26.
 - Decision Analysis Techniques, Safety Notice 95-01, DOE/EH-0500.
- d. For Supporting Knowledge and Skills **1.24-1.d** refer to:
 - DOE Performance Indicators Guidance Document (DOE-STD-1048-92), Section 2, page 2.
 - Trending and Analysis of Operations Information Using Performance Indicators (DOE Order 5480.26), Section 7.

4. Practice Exercise

- a. List examples of proven and accepted techniques for analyzing information to determine causes of problems. (K&S 1.24-1.a)
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- b. What are the three (3) criteria an acceptable root cause should meet? (K&S 1.24-1.a)
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- c. Discuss the relationship between trending and analysis of operations information and facility maintenance management activities. (K&S 1.24-1.a)

d. Discuss the importance of maintaining a maintenance history. (K&S 1.24-1.b)

e. Discuss the key items of an equipment identification within a maintenance history.
(K&S 1.24-1.b)

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- f. Discuss the key items of data identification within a maintenance history. (K&S 1.24-1.b)

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The specific data to be collected should include:

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- g. What are the five phases of a root cause investigation process? (K&S 1.24-1.c) (K&S 1.24-1.e)

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- h. List six common root cause analysis methods. (K&S 1.24-1.c) (K&S 1.24-1.e)

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- i. What types of charts are used when dealing with counts of a given event over consecutive periods of time? (K&S 1.24-1.c) (K&S 1.24-1.e)
 - 1) C-charts
 - 2) Distribution charts
 - 3) "rate" charts
 - 4) U-charts
 - 5) X-charts
- j. What are the six (6) steps involved in the analysis of individual measured quantities for indicators of process control or unusual variation? (K&S 1.24-1.c) (K&S 1.24-1.e)
 - 1.
 - 2.
 - 3.
 - 4.
 - 5.
 - 6.
- k. Concerning DOE Order 5480.26, Trending and Analysis of Operations Information Using Performance Indicators, answer the following questions: (K&S 1.24-1.d)
 - (1) Which DOE facilities must make Performance Indicator reports?
 - (2) How often must the Performance Indicator reports be performed?

- (3) Which document provides additional information addressing the format and content of the Performance Indicator Reports?
- l. Concerning the Performance Indicator Reports, what data must be reported pertaining to "PI 4.4 Corrective Maintenance Backlog"? (K&S 1.24-1.d)
- m. What is the purpose of monitoring the Preventive Maintenance Overdue? (K&S 1.24-1.d)
- n. As part of an exercise for this section, review incident/occurrence report data from the last two years for a specific piece of equipment. Analyze the information for safety trends or compliance problems. This information can be gathered from local files manually, using the Operating Experience Weekly Summaries or Occurrence Reporting and Processing System (ORPS). Discuss the findings and corrective recommendations with your supervisor. (K&S 1.24-1.c) (K&S 1.24-1.e)

5. Practice Exercise Answers

- a. List examples of proven and accepted techniques for analyzing information to determine causes of problems. (K&S 1.24-1.a)
- event and causal factor charting
 - walk-through task analysis
 - fault tree analysis
 - change analysis
 - barrier analysis
- b. What are the three (3) criteria an acceptable root cause should meet? (K&S 1.24-1.a)
- Its correction should:
- prevent reoccurrence of the unplanned occurrence;
 - be feasible; and
 - **NOT** adversely impact safety, reliability, or operational goals
- c. Discuss the relationship between trending and analysis of operations information and facility maintenance management activities. (K&S 1.24-1.a)
- Systematic analysis should be used to determine and correct the root causes of unplanned occurrences related to maintenance. Maintenance management (§ 16) provides guidance for collecting and trending maintenance history for recurring or persistent equipment failures that should be reviewed by the analysis program. Incident reports, post-trip reviews, and other similar operating experience methods supplement the maintenance history program and provide data, including human error data, which should be reviewed by the analysis program.

An analysis program may be used effectively to reduce recurring maintenance problems by identifying and resolving root causes of the problem.

- d. Discuss the importance of maintaining a maintenance history. (K&S 1.24-1.b)

Maintenance history and trending program should be maintained to document data, provide historical information for maintenance planning, and support maintenance and performance trending of facility systems and components.

Maintenance history programs can be used to improve:

- the balance of corrective and preventive maintenance (DOE 4330.4B paragraph 5)
- the planning, scheduling, and coordination of maintenance (DOE 4330.4B paragraph 7)
- the analysis of maintenance problems (DOE 4330.4B paragraph 17).

Maintenance history file can be used by plant management to identify trends that indicate a need for corrective action and by work planners as a reference to assist in the work planning process.

- e. Discuss the key items of an equipment identification within a maintenance history. (K&S 1.24-1.b)

Maintenance history program should clearly define the systems and equipment that require documentation and retention of historical data. Systems and components that affect safe and reliable facility operation should be documented. Equipment requiring repetitive maintenance should also be included in this program.

- equipment unique identification number and name
- system, manufacturer, model, serial number, and other appropriate name plate data
- lubrication data
- applicable vendor manuals and drawings
- spare parts reference numbers
- common equipment cross-references

The master equipment list (DOE 4330.4B paragraph 5) could be used effectively to establish this information.

- f. Discuss the key items of data identification within a maintenance history. (K&S 1.24-1.b)

The maintenance history program should define the type of data that should be collected and recorded to effectively support the use of the program. Some examples of the data that should be included or cross referenced in the program are:

- corrective maintenance records
- preventive maintenance records
- modification packages
- vendor repair information
- startup test and other baseline data
- surveillance test data
- calibration data
- applicable industry experience information

The specific data to be collected should include:

- details of the work performed
- special equipment and tools used
- procedures and drawings needed
- spare parts installed
- personnel safety and radiation protection requirements
- post maintenance testing
- information that maybe useful at a later date.

- g. What are the five phases of a root cause investigation process? (K&S 1.24-1.c) (K&S 1.24-1.e)

- Data Collection
- Assessment
- Corrective Actions
- Inform
- Follow-up

- h. List six common root cause analysis methods. (K&S 1.24-1.c) (K&S 1.24-1.e)

- Events and causal factor analysis
- Change analysis
- Barrier analysis
- Management Oversight and Risk Tree (MORT) analysis
- Human Performance Evaluation
- Kepner-Tregoe Problem Solving and Decision Making

- i. What types of charts are used when dealing with counts of a given event over consecutive periods of time? (K&S 1.24-1.c) (K&S 1.24-1.e)

1) C-charts

2) Distribution charts

3) "rate" charts

4) U-charts

5) X-charts

- j. What are the steps involved in the analysis of individual measured quantities for indicators of process control or unusual variation? (K&S 1.24-1.c) (K&S 1.24-1.e)

1. Assemble the data for the periods of interest.
2. Calculate the average of the individual values.
3. Calculate the individual moving ranges (all ranges will be positive numbers).
4. Average the ranges.
5. Calculate the standard deviation and subsequent UCL and LCL for the individual values.
6. Plot the average and limit lines for the individual values and analyze for trends.

- k. Concerning DOE Order 5480.26, Trending and Analysis of Operations Information Using Performance Indicators, answer the following questions: (K&S 1.24-1.d)

- (1) Which DOE facilities must make Performance Indicator reports?
Contractors of all DOE facilities included in the DOE performance indicator (PI) program.
- (2) How often must the Performance Indicator reports be performed?
On a quarterly basis.

- (3) Which document provides additional information addressing the format and content of the Performance Indicator Reports?

DOE-STD-1048-92

- l. Concerning the Performance Indicator Reports, what data must be reported pertaining to "PI 4.4 Corrective Maintenance Backlog"? (K&S 1.24-1.d)
- Number of open items >90 days old.
 - Total number of open items.

- m. What is the purpose of monitoring the Preventive Maintenance Overdue? (K&S 1.24-1.d)

The purpose of the indicator is to monitor progress in the administration and execution of facility preventive maintenance programs. A small percentage of preventive maintenance items overdue indicates a management and staff commitment to the preventive maintenance program and an ability to plan, schedule, and perform preventive maintenance tasks as programs require. A facility with a good preventive maintenance program should require less emergency maintenance, which may be reflected in improved safety and reliability and more efficient operation.

- n. As part of an exercise for this section, review incident/occurrence report data from the last two years for a specific piece of equipment. Analyze the information for safety trends or compliance problems. This information can be gathered from local files manually, using the Operating Experience Weekly Summaries or Occurrence Reporting and Processing System (ORPS). Discuss the findings and corrective recommendations with your supervisor. (K&S 1.24-1.c) (K&S 1.24-1.e)

Competency 1.25

Technical manager (FAC# 1.2) shall demonstrate a familiarity level knowledge of formal conduct of maintenance necessary to ensure implementation.

1. Supporting Knowledge and/or Skills
 - a. State the applicability and discuss the purpose of DOE Order 4330.4B, Maintenance Management Program.
 - b. Using DOE Order 4330.4B as a reference, describe the roles and responsibilities of the technical manager in implementing an effective maintenance program.
 - c. Describe a typical work control process including a discussion of the key elements necessary to ensure safety.
 - d. Identify and discuss the types of contractor management systems needed to ensure effective and safe maintenance activities.
 - e. Explain the importance of an effective preventative maintenance program.
 - f. Identify typical maintenance performance indicators, and discuss their importance to safety.
 - g. Identify the important elements of a contractor maintenance plan, and the technical manager's role in its approval and management.
 - h. Discuss how maintenance activities interface with conduct of operations, quality assurance, and configuration management.

Chapter Technical Managers and Maintenance Management

2. Self-Study Information

Competency 1.25 addresses the technical manager's knowledge related to the conduct of maintenance. Competency 1.25 is at a familiarity level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Conduct of Operations, DOE Order 5480.19
- Quality Assurance, DOE Order 5700.6C
- DOE Performance Indicators Guidance Document, DOE-STD-1048-92
- Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities, DOE-STD-1051-93
- Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities, DOE-STD-1052-93
- Guide for Operational Configuration Management Program, DOE-STD-1073-93-Pts. 1

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.25-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 1, page 1 and Section 2, page I-3.
- b. For Supporting Knowledge and Skills **1.25-1.b** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 9.f, page 6 - 7 and Section 10.a, page 7 - 8; Section 15, page II-79 - II-91.
- c. For Supporting Knowledge and Skills **1.25-1.c** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 3.4.1, page I-17 - I-19 and Section 8.3.1, page II-46 - II-47.
- d. For Supporting Knowledge and Skills **1.25-1.d** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 2.1 and 2.2, page II-3 - II-4.
 - Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities, (DOE-STD-1051-93).

Chapter Technical Managers and Maintenance Management

- e. For Supporting Knowledge and Skills **1.25-1.e** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 5.2, page II-19 - II-21 and Section 5.3.3, pages II-24 - II-25.
 - Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities, (DOE-STD-1052-93), Section 3.1.1, page 6; Section 3.4.1, page 10; Section 3.4.3.1, page 10; Section 3.4.3.6, page 12; and Appendix D Section 5, page D-8.
- f. For Supporting Knowledge and Skills **1.25-1.f** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.7.3, page I-42 - I-43 and Section 2.3.4, pages II-7 - II-8.
 - DOE Performance Indicators Guidance Document, (DOE-STD-1048-92), Section 1 page 1.
 - Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Sections 4.3.2.b and .c, pages 22 - 24.
- g. For Supporting Knowledge and Skills **1.25-1.g** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Table of Contents, pages i - v; Section 10, pages 7 - 9; and Section 3.3.1, page I-15 - I-17.
- h. For Supporting Knowledge and Skills **1.25-1.h** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 1, page I-1; Section 1, page II-1; Section 8.2, page II-47; Section 16.2, page II-84 - II-85; and Section 18.3.1, page II-95.
 - Conduct of Operations (DOE Order 5480.19), General Introduction, Attachment I, page I-12.
 - Quality Assurance (DOE Order 5700.6C), Section 7, page 4 and Section 9.b, pages 5 - 7.
 - Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Section 4.3.4, pages 26 - 28.
 - Guide for Operational Configuration Management Program, DOE-STD-1073-93-Pts. 1, Appendix I-A page I-A-2 - I-A-3.

4. Practice Exercise

- a. Explain the purpose of the DOE Order 4330.4B, Maintenance Management Program. (K&S 1.25-1.a)

- b. Describe the roles and responsibilities of the technical manager in implementing an effective maintenance program. (K&S 1.25-1.b)

- c. Describe the key elements of a typical work control process. (K&S 1.25-1.c)

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Chapter Technical Managers and Maintenance Management

- d. Describe the elements of an effective work control program and the documentation used to control maintenance. (K&S 1.25-1.c)

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Chapter Technical Managers and Maintenance Management

- e. Explain the importance of an effective preventative maintenance program. (K&S 1.25-1.e)
- f. List maintenance goals that can be used as a management tool for improving maintenance performance and measuring maintenance effectiveness. (K&S 1.25-1.f)
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- g. When developing lists of maintenance activities to monitor for performance, what type of activities should the emphasis be placed on? (K&S 1.25-1.f)

Chapter Technical Managers and Maintenance Management

- h. Identify the key elements and sub elements of a contractor maintenance plan as required by DOE Order 4330.4B, Maintenance Management Program. (K&S 1.25-1.g)

Non-nuclear Facilities	Nuclear Facilities
ELEMENT	ELEMENT
SUB-ELEMENTS	SUB-ELEMENTS
ELEMENT	ELEMENT
SUB-ELEMENTS	SUB-ELEMENTS
ELEMENT	ELEMENT
SUB-ELEMENTS	SUB-ELEMENTS
ELEMENT	ELEMENT
SUB-ELEMENTS	SUB-ELEMENTS

Chapter Technical Managers and Maintenance Management

Non-nuclear Facilities	Nuclear Facilities
ELEMENT	ELEMENT
SUB-ELEMENTS	SUB-ELEMENTS
ELEMENT	ELEMENT
SUB-ELEMENTS	SUB-ELEMENTS
ELEMENT	ELEMENT
SUB-ELEMENTS	SUB-ELEMENTS
	ELEMENT
	SUB-ELEMENTS
	ELEMENT
	SUB-ELEMENTS

Chapter Technical Managers and Maintenance Management

Non-nuclear Facilities	Nuclear Facilities
	ELEMENT
	SUB-ELEMENTS
	ELEMENT
	SUB-ELEMENTS
	ELEMENT
	SUB-ELEMENTS
	ELEMENT
	SUB-ELEMENTS
	ELEMENT
	SUB-ELEMENTS
	ELEMENT
	SUB-ELEMENTS

Chapter Technical Managers and Maintenance Management

Non-nuclear Facilities	Nuclear Facilities
	ELEMENT
	SUB-ELEMENTS
	ELEMENT
	SUB-ELEMENTS
	ELEMENT
	SUB-ELEMENTS
	ELEMENT
	SUB-ELEMENTS

- i. Who are Maintenance Implementation Plans for nuclear Facilities submitted to for approval? (K&S 1.25-1.g)

Chapter Technical Managers and Maintenance Management

- j. For each of the following Maintenance Management Program Elements identify a Conduct of Operations Element that when integrated will lead to an enhancement in the Maintenance Element. Note: In some cases the ConOps elements may apply to more than Maintenance Element. (K&S 1.25-1.h)

Maintenance element	Conduct of Operations element
Training and Qualification of Maintenance Personnel	
Planning, Scheduling, and Coordination of Maintenance	
Control of Maintenance Activities	
Post-Maintenance Testing	
Facility Condition Inspection	
Maintenance History	
Analysis of Maintenance Problems	
Modification Work	

Chapter Technical Managers and Maintenance Management

- k. For each Maintenance Management Program Element below, identify a Quality Assurance Criteria that would be used in the development and/or implementation of the Maintenance Program. Note: In some cases the QA Criterion may apply to more than one Maintenance element. (K&S 1.2-1.f)

Maintenance element	Criterion # and name
Maintenance Organization and Administration	Criterion
Training and Qualification of Maintenance Personnel	Criterion
Maintenance Facilities, Equipment and Tools	Criterion
Types of Maintenance	Criterion
Maintenance Procedures	Criterion
Planning, Scheduling, and Coordination of Maintenance	Criterion
Control of Maintenance Activities	Criterion
Post-Maintenance Testing	Criterion
Procurement of Parts, Materials, and Services	Criterion
Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance	Criterion
Control and Calibration of Measuring and Test Equipment	Criterion
Maintenance Tools and Equipment Control	Criterion
Facility Condition Inspection	Criterion
Management Involvement	Criterion
Maintenance History	Criterion
Analysis of Maintenance Problems	Criterion
Modification Work	Criterion

Chapter Technical Managers and Maintenance Management

1. Discuss the relationship between maintenance and Configuration Management. (K&S 1.25-1.h)

5. Practice Exercise Answers

- a. Explain the purpose of the DOE Order 4330.4B, Maintenance Management Program. (K&S 1.25-1.a)

The purpose of DOE Order 4330.4B, Maintenance Management Program, is to provide a general policy and objectives for the establishment of programs for the management and performance of cost effective maintenance and repair of Department of Energy property.

Maintenance management is the administration of a program utilizing concepts such as planning, procedures, schedules, cost control, and evaluation for the effective performance and control of maintenance, with adequate provisions for interfaces with other concerned disciplines such as health, safety, environmental compliance, quality control, and security.

- b. Describe the roles and responsibilities of the technical manager in implementing an effective maintenance program. (K&S 1.25-1.b)

The DOE Technical Manager in a position to provide regulatory oversight of the contractor's maintenance program is responsible through the organizational structure to ensure the requirements of DOE Order 4330.4B section 10.a are met as implemented by Chapters I and II utilizing a graded approach.

- c. Describe the key elements of a typical work control process. (K&S 1.25-1.c)

The work control procedures should describe the work request form, including applicable attachments, and should, as a minimum, address the following:

- personnel responsibilities for identifying deficiencies and initiating work requests that adequately describe the symptoms or problems
- supervisory responsibility for controlling the conduct of maintenance activities and processing work requests
- description of the process for initiating and processing the work request, including the pre-job review, approval cycle, and post-job review
- definition of the priorities used to schedule work
- determination of the impact of maintenance activities on facility operations
- work planning and scheduling
- the conduct of routine maintenance planning meetings
- requirements for personnel and equipment safety and radiological protection
- post-maintenance testing
- collection of maintenance history.

Chapter Technical Managers and Maintenance Management

- d. Describe the elements of an effective work control program and the documentation used to control maintenance. (K&S 1.25-1.c)

The work control program is an administrative method by which maintenance activities are identified, initiated, planned, approved, scheduled, coordinated, performed, and reviewed for adequacy and accuracy. The program should address the following areas:

- Administrative procedures should describe the control of work from identification and planning through completion, review and storage of history data. Personnel involved in the conduct and support of maintenance should be trained in the use of these procedures.
- The responsibility for various types of work should be identified.
- A work request form (and/or work package) should be prepared and used to direct and document maintenance activities. This form should provide for documented review at the appropriate level. The work request should be used to control maintenance activities by ensuring correct equipment isolation, personnel safety, and the proper conduct of maintenance and post-maintenance tests.
- Troubleshooting should be controlled to prevent unplanned repairs and unauthorized modifications.
- The requested work should be reviewed to ensure unauthorized modifications are not accomplished by the maintenance request.
- Goals for high quality workmanship, safe work practices, and improving radiological protection should be emphasized to maintenance personnel. A key factor in achieving these goals is worksite guidance and overview provided by maintenance supervisors. Monitoring to identify rework can be effectively used to identify programmatic or qualification deficiencies.
- Work accomplished and the results of post maintenance tests, including satisfactory return to service of the equipment, should be documented.
- Work requests should be reviewed following the completion of maintenance to verify that the activity was satisfactorily completed in accordance with facility procedures and standards and to capture maintenance history data.
- Temporary repairs should be performed under the facility's temporary modification program to provide engineering review of the adequacy of the temporary repair and a means for identifying required permanent repair.
- Non-facility contractor personnel and subcontractors conducting maintenance should be controlled and held accountable to the same policies and procedures as facility personnel.

Chapter Technical Managers and Maintenance Management

- e. Explain the importance of an effective preventative maintenance program. (K&S 1.25-1.e)

An effective preventive maintenance program identifies and services equipment before degradation and failure of the equipment. The program balances the costs associated with the preventive maintenance against the improved facility reliability and availability and by reduced corrective maintenance.

- f. List maintenance goals that can be used as a management tool for improving maintenance performance and measuring maintenance effectiveness. (K&S 1.25-1.f)
- minimize the impact on planned outages by planning and completing maintenance activities in a timely manner;
 - minimize the number of forced outages;
 - minimize the lost-time accident rate;
 - minimize facility and equipment downtime;
 - minimize personnel errors;
 - minimize process delays in work controls and work execution;
 - minimize radiological exposure consistent with DOE 5480.11 Radiation Protection for Occupational Workers;
 - control and reduce contaminated areas;
 - reduce repeat maintenance work requests (rework);
 - complete scheduled surveillances and preventive maintenance activities in a timely manner;
 - minimize the maintenance backlog and reduce the completion time of outstanding deficiencies;
 - control overtime; and
 - complete outage and non-outage work on schedule.
- g. When developing lists of maintenance activities to monitor for performance, what type of activities should the emphasis be placed on? (K&S 1.25-1.f)
- The emphasis should be on activities that affect safe and reliable plant operations.

Chapter Technical Managers and Maintenance Management

- h. Identify the key elements and sub elements of a contractor maintenance plan as required by DOE Order 4330.4B, Maintenance Management Program. (K&S 1.25-1.g)

Non-nuclear Facilities	Nuclear Facilities
Organization, Administration, and Training	Maintenance Organization and Administration
Organization/Staffing Administration Policies, Goals, and Objectives Training and Qualification	Maintenance Organization Policies Maintenance Strategies Staffing Resources Goals and Objectives Accountability
Condition of Facilities and Equipment	Training and Qualification of Maintenance Personnel
Facility Condition Inspection by Management Condition Assessment Surveys	Responsibilities Maintenance Training Programs Training Schedules and Support On-the-Job Training Qualification Training in Root Cause Analysis Training Program Approval, Effectiveness, and Feedback Management and Supervisory Training
Maintenance Documentation	Maintenance Facilities, Equipment and Tools
Site Maintenance Plan	Facilities Tools and Equipment Storage Office Equipment

Chapter Technical Managers and Maintenance Management

Non-nuclear Facilities	Nuclear Facilities
Work Control System	Types of Maintenance
Work Request (Order) System Formal Job Planning and Estimating Work Performance (Time) Standards Priority System Maintenance Procedures and Other Work-Related Documents Scheduling System Post-Maintenance Testing Backlog Work Order Control Equipment Repair History and Vendor Information	Master Equipment List (MEL) Types of Maintenance Maintenance Action and Frequency Selection Scheduling
Maintenance Facilities, Equipment, and Materials Control System	Maintenance Procedures
Maintenance Facilities, Equipment, and Tools Requisitioning/Procurement Materials Control Control and Calibration of Measuring and Test Equipment Maintenance Tools and Equipment Controls	Procedure Development and Writing Procedure Verification Procedure Validation Procedure Approval Procedure Use Procedure Control, Periodic Review, and Revision
Implementation of Maintenance Activities	Planning, Scheduling, and Coordination of Maintenance
Surveillance and Preventive Maintenance Predictive Maintenance Corrective (Repair) Maintenance Modification Work	Planning for Maintenance Activities Scheduling Maintenance Activities Coordination of Maintenance Activities Outage Planning, Scheduling, and Coordination

Chapter Technical Managers and Maintenance Management

Non-nuclear Facilities	Nuclear Facilities
Maintenance Evaluation and Analysis	Control of Maintenance Activities
Analysis of Root Causes of Problems Periodic Review and Analysis Performance Measurement and Improvement Management Involvement Work Sampling Cost and Identification Control Audits and Lessons Learned	Work Control Procedures Work Requests Supervision of Maintenance Activities Review of Completed Work Requests Temporary Repairs Control of Non-facility Contractor and Subcontractor Personnel
	Post-Maintenance Testing
	Post-Maintenance Test Requirements Post-Maintenance Test Program Scope Post-Maintenance Test Control Post-Maintenance Test Performance, Documentation, and Acceptance
	Procurement of Parts, Materials, and Services
	Procurement Policy and Procedures Procurement Initiation Procurement Control Services
	Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance
	Receipt and Inspection Handling Storage Material and Equipment Retrieval and Issuance
	Control and Calibration of Measuring and Test Equipment
	Identification Calibration Control Evaluation

Chapter Technical Managers and Maintenance Management

Non-nuclear Facilities	Nuclear Facilities
	Maintenance Tools and Equipment Control
	Storage and Issuance Tool and Equipment Maintenance Use of Special Tools and Equipment
	Facility Condition Inspection
	Standards Training Procedures Scope of Inspections Inspection Program Elements Reporting Deficiencies Deficiency Follow up
	Management Involvement
	Manager Involvement Performance Indicators, Goals, and Objectives Feedback Program Reviews
	Maintenance History
	Program Development Data Collection Program Use
	Analysis of Maintenance Problems
	Information Collection Event Analysis Cause Determination Corrective Action Corrective Action Followup Generic Followup
	Modification Work

Chapter Technical Managers and Maintenance Management

Non-nuclear Facilities	Nuclear Facilities
	Maintenance Program Interface with Modifications Temporary Repairs/Temporary Modifications
	Additional Maintenance Management Requirements
	Seasonal Facility Preservation Requirements

- i. Who are Maintenance Implementation Plans for nuclear Facilities submitted to for approval? (K&S 1.25-1.g)
Maintenance Implementation Plans are submitted to the Managers of field elements.

Chapter Technical Managers and Maintenance Management

- j. For each of the following Maintenance Management Program Elements identify a Conduct of Operations Element that when integrated will lead to an enhancement in the Maintenance Element. Note: In some cases the ConOps elements may apply to more than Maintenance Element. (K&S 1.25-1.h)

Maintenance element	Conduct of Operations element
Training and Qualification of Maintenance Personnel	Control of On-shift Training
Planning, Scheduling, and Coordination of Maintenance	Operations Turnover
Control of Maintenance Activities	Shift Routines and Operating Practices
Post-Maintenance Testing	Control of Equipment and System Status
Facility Condition Inspection	Equipment and Piping Labeling
Maintenance History	Logkeeping
Analysis of Maintenance Problems	Investigation of Abnormal Events
Modification Work	Control of Equipment and System Status

Chapter Technical Managers and Maintenance Management

- k. For each Maintenance Management Program Element below, identify a Quality Assurance Criteria that would be used in the development and/or implementation of the Maintenance Program. Note: In some cases the QA Criterion may apply to more than one Maintenance element. (K&S 1.2-1.f)

Maintenance element	Criterion # and name
Maintenance Organization and Administration	Criterion 1, Program
Training and Qualification of Maintenance Personnel	Criterion 2, Personnel Training and Qualifications
Maintenance Facilities, Equipment and Tools	Criterion 5, Work Process
Types of Maintenance	Criterion 5, Work Process
Maintenance Procedures	Criterion 5, Work Process
Planning, Scheduling, and Coordination of Maintenance	Criterion 1, Program
Control of Maintenance Activities	Criterion 5, Work Process
Post-Maintenance Testing	Criterion 8, Inspection and Acceptance Testing
Procurement of Parts, Materials, and Services	Criterion 7, Procurement
Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance	Criterion 5, Work Process
Control and Calibration of Measuring and Test Equipment	Criterion 8, Inspection and Acceptance Testing
Maintenance Tools and Equipment Control	Criterion 5, Work Process
Facility Condition Inspection	Criterion 10, Independent Assessment
Management Involvement	Criterion 9, Management Assessment
Maintenance History	Criterion 4, Document and Records
Analysis of Maintenance Problems	Criterion 3, Quality Improvement
Modification Work	Criterion 6, Design

Chapter Technical Managers and Maintenance Management

1. Discuss the relationship between maintenance and Configuration Management. (K&S 1.25-1.h)

DOE 4330.4B addresses the need for and conduct of maintenance through predictive and preventive maintenance. However it does not provide technical guidance on how the establishment and or forecasting of degradation of equipment, structures, systems, or components (SSC). The Configuration Management process addresses Material Condition and Aging Management (MCA). MCA develops analytical methods and testing techniques that can be used to meet the requirements of the maintenance program.

Configuration Management program also interfaces with the maintenance program through the change control and document control elements, which address control of hardware and procedure changes. The main interface is through the work control process of the maintenance program which manages and sequences maintenance activities in the field. Another important interface exists between the preventive and predictive maintenance activities and the performance monitoring function of the assessment element.

Configuration control is maintained by ensuring that systems and equipment are restored to their original condition following maintenance.

Competency 1.26

Facility Representative (FAC# 4.5) personnel shall demonstrate a working level knowledge of Conduct of Maintenance principles and Department of Energy requirements to ensure maintenance is performed in a safe and efficient manner.

1. Supporting Knowledge and/or Skills

- a. Explain the Department of Energy's role in the oversight of contractor maintenance operations.
- b. Describe work activity observation skills.
- c. Explain the intent of DOE Order 4330.4A "Maintenance Management Program".
- d. Define each of the following maintenance related terms and explain their relationship to each other:
 - Corrective
 - Preventive
 - Periodic
 - Planned
 - Reliability Centered
- e. Explain the purpose and content of a Master Equipment List.
- f. Observe a contractor preventive maintenance activity and describe the preventive maintenance factors to be considered as the activity is planned.
- g. Observe Post-Maintenance Testing and discuss the activity including several examples of maintenance activities to which Post-Maintenance Testing would be applied.
- h. Describe the procedure development, verification, and validation process.
- i. Explain the purpose of maintaining good facility condition and house-keeping.
- j. Conduct a facility observation walk through and identify deficiencies often found with respect to Material, House-Keeping, Industrial Safety, and Radiological areas.
- k. Describe configuration control and its relationship to the maintenance work control process and the maintenance history file.

Chapter Facility Representative and Maintenance Management

- l. Explain the intent of a Maintenance Problem Analysis Program and discuss a maintenance problem where this program has been recently employed.
- m. Explain facility management's role in facility maintenance.
- n. Describe the principles of instrument calibration to ensure safe and efficient operation.
- o. Conduct an assessment of maintenance activities.

To participate in an assessment, contact your supervisor or Quality organization to make the necessary arrangements.

2. Self-Study Information

Competency 1.26 addresses principles regarding the conduct of maintenance and requirements of the Department of Energy to ensure maintenance is performed in a safe and efficient manner. Competency 1.26 is at a working level of knowledge.

The supporting material for the Self-Study Information include the following documents:

- Maintenance Management Program, DOE Order 4330.4B
- Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities, DOE-STD-1051-93
- Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities, DOE-STD-1052-93
- Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities, DOE-STD-1054-93
- Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities, DOE-STD-1055-93
- Guide to Good Practices for Maintenance Supervisor Selection and Development DOE-STD-1059-93
- Guideline To Good Practice For Post Maintenance Testing At DOE Nuclear Facilities, DOE-STD-1065-94
- Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities, DOE-STD-1072-94
- Guide for Operational Configuration Management Program, DOE-STD-1073-93-Pt.1
- Operations Assessments, DOE-EM-STD-5505-96¹
- Post-Maintenance Test Programs, Office of Nuclear and Facility Safety, Safety Notice 95-

¹ While this reference was designed for the EM Assessment Program, it is an excellent source of general assessment program process information.

Chapter Facility Representative and Maintenance Management

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- DOE Maintenance Management Topical Area Self Study Guide (SR-TA-MNT-SSG-01)
- DOE Conduct of Assessments Topical Area Self Study Guide (SR-TA-COA-SSG-01)
- IEEE Standard Requirements for the Calibration and Control of Measuring and Test Equipment Used in the Construction Nuclear Facilities², IEEE Std. 498-1990
- Savannah River Implementing Procedure (SRIP) 5700.6.12B, SR Technical Assessment Program
- Savannah River Site Lead Assessor/Auditor Training

3. References

NOTE: For information regarding the Supporting Knowledge and Skills refer to the Self-Study Information section of this competency.

- a. For Supporting Knowledge and Skills **1.26-1.a** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 9, pages 4- 7 and Section 1, page II-2.
- b. For Supporting Knowledge and Skills **1.26-1.b** refer to:
 - Guide to Good Practices for Maintenance Supervisor Selection and Development, (DOE-STD-1059-93) Section A.3.1, page A-8.
 - Operations Assessments (DOE-EM-STD-5505-96), Section 5.8, pages 14 - 25.
 - Savannah River Site Lead Assessor/Auditor Training Chapter 6, Sections 4.0 through 4.7.
 - Savannah River Implementing Procedure (SRIP) 5700.6.12B, SR Technical Assessment Program, Attachment B, Conduct of Field Personnel, or use applicable site documents.
 - DOE Conduct of Assessments Topical Area Self Study Guide (SR-TA-COA-SSG-01).
- c. For Supporting Knowledge and Skills **1.26-1.c** refer to:
 - Maintenance Management Program (DOE Order 4330.4B), Section 1, page 1; Sections 7 and 8, pages 3 - 4; and Section 2, page I-3.

² This standard was withdrawn in 1995. It is superseded by Nuclear Power Collection IEEE-1990.

Chapter Facility Representative and Maintenance Management

- d. For Supporting Knowledge and Skills **1.26-1.d** refer to:
- (1) Maintenance Management Program (DOE Order 4330.4B), Section 3.6.3, pages I-38 - I-39 and Section 5.3.2.a, pages II-21 - II-22.
 - (2) Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities (DOE-STD-1052-93), Section 2.1.5, pages 5 and Appendix D.
 - (3) Maintenance Management Program (DOE Order 4330.4B), Section 5.2, page II-20.
 - (4) Maintenance Management Program (DOE Order 4330.4B), Section 3.6.2, pages I-37 - I-38 and Section 5.3.2.c, pages II-23 - II-24.
Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities (DOE-STD-1052-93), Section 3.4.4, pages 13 - 20.
 - (5) Maintenance Management Program (DOE Order 4330.4B), Section 3.6.1, page I-35; Section 5.2, page II-19 - II-21.
 - () Maintenance Management Program (DOE Order 4330.4B), Section 3.6.1, pages I-35 - I-37 and Section 5.3.2.b, pages II-22 - II-23.
Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities (DOE-STD-1052-93), Section 3.4.3, pages 10 - 13.
- e. For Supporting Knowledge and Skills **1.26-1.e** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 5.3.1, page II-21.
 - Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities (DOE-STD-1052-93), Sections 2.9 and 3.4.1, pages 4 and 10.
- f. For Supporting Knowledge and Skills **1.26-1.f** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 5.3.3, pages II-24 - II-25.
- g. For Supporting Knowledge and Skills **1.26-1.g** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.4.7, page I-25 - I-26; Section 9.3.2, pages II-52 - II-54; Section 9.3.3, pages II-54 - II-55; and Section 9.3.4, pages II-55 - II-56.
 - Guideline To Good Practice For Post Maintenance Testing At DOE Nuclear Facilities (DOE-STD-1065-94), Section 3.4.1, pages 9 - 10 and Section 3.4.3, pages 13 - 14.
 - Post-Maintenance Test Programs (Office of Nuclear and Facility Safety, Safety Notice 95-04 DOE/EH-0513).
- h. For Supporting Knowledge and Skills **1.26-1.h** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.4.5, page I-22 - I-24; Section 6.2, page II-26; and Sections 6.3.2, 6.3.3, 6.3.4 and 6.3.5, pages II-28 - II-29.

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- i. For Supporting Knowledge and Skills **1.26-1.i** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 14.1, pages II-72 - II-73.
 - Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities (DOE-STD-1072-94), Section 1.1, pages 1 - 2.
- j. For Supporting Knowledge and Skills **1.26-1.j** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 3.2.1, page I-14 - I-15; Section 14.2, pages II-73 - II-74; Section 14.3.1, pages II-74 - II-76; Section 14.3.2, 14.3.3, 14.3.4 and 14.3.5, pages II-76 - II-77.
 - Guideline to Good Practices for Facility Condition Inspections at DOE Nuclear Facilities (DOE-STD-1072-94), Section 3.1, pages 5 - 6 and Section 3.4.1 - 3.4.5, pages 8 - 10.
- k. For Supporting Knowledge and Skills **1.26-1.k** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 8.2, page II-46; Section 16.2, page II-84 - II-85 and Section 18.3.1, page II-95.
 - Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities (DOE-STD-1051-93), Section 4.3.4, pages 26 - 28.
 - Guide for Operational Configuration Management Program (DOE-STD-1073-93-Pt.1), Section 1.2, pages I-4 - I-5 and Appendix I-A, pages I-A-2 - I-A-3.
- l. For Supporting Knowledge and Skills **1.26-1.l** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 17.2, page II-88.
- m. For Supporting Knowledge and Skills **1.26-1.m** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Sections 15.2 and 15.3.1, pages II-79 - II-80.
 - Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities (DOE-STD-1055-93), Sections 2.1 and 2.2.1, pages 3 - 5.
- n. For Supporting Knowledge and Skills **1.26-1.n** refer to:
- Maintenance Management Program (DOE Order 4330.4B), Section 12.3.2, pages II-66 - II-67.
 - Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities (DOE-STD-1054-93), Section 3.4.4, pages 13 - 15.
 - IEEE Standard Requirements for the Calibration and Control of Measuring and Test Equipment Used in the Construction Nuclear Facilities (IEEE Std. 498-1990), Section 5.1, page 10.

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- o. For Supporting Knowledge and Skills **1.26-1.o** refer to:
- Operations Assessments (DOE-EM-STD-5505-96).
 - DOE Maintenance Management Topical Area Self Study Guide (SR-TA-MNT-SSG-01) Competency 1.18.
 - DOE Conduct of Assessments Topical Area Self Study Guide (SR-TA-COA-SSG-01).

The Maintenance Management Program described in DOE Order 4330.4B incorporates the concepts included in DOE Order 5480.19 associated with matters related to the maintenance program. For example, the guidance provided for maintenance procedures is consistent with the procedure direction provided in the Conduct of Operations Order. Additionally, the "cultural" aspects of ConOps is easily integrated into the Maintenance Program. These are "best business" practices that should result in the high standard of maintenance performance required to support safe and reliable operations.

The concepts identified in DOE Order 5700.6C were utilized in the development of the Maintenance Management Program described in DOE Order 4330.4B. The Quality Assurance requirements stipulated were established and integrated into the Maintenance Management Program Order to ensure that risks and environmental impacts were minimized and that safety, reliability and performance were maximized through the application of effective management systems commensurate with the risks posed by the facility and its maintenance activities. Specifically, the principles of each Quality Assurance Criteria, in the areas of Management, Performance and Assessment, were evaluated for inclusion into each Maintenance Management Program Element.

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4. Practice Exercise

- a. Within the Department of Energy, who is responsible to review the maintenance backlog and establish plans to ensure the backlog remains consistent with DOE goals and objectives? (K&S 1.26-1.a)
- b. What guidance should field element managers, contractor managers, and staff members use for oversight of facility programs supporting maintenance? (K&S 1.26-1.a)
- c. What are the eleven (11) items that should be considered to perform an observation? (K&S 1.26-1.b)
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- d. In preparing for and conducting observations, what actions can assist the evaluator in data collection with field notes. (K&S 1.26-1.b)
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- e. What is the importance of note taking? (K&S 1.26-1.b)

- f. What information should be included in evaluator notes? (K&S 1.26-1.b)

- g. Explain the intent of the DOE Order 4330.4B, Maintenance Management Program. (K&S 1.26-1.c)

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- h. Match the definition in column A with the term in column B. Use the column B answers one time only. Ignore any response in column B not identified in column A. (K&S 1.26-1.d)

Column A	Column B
___ 1. The repair of failed or malfunctioning equipment, system, or facilities to restore the intended function or design condition. This maintenance does not result in significant extension of expected useful life.	a. Planned
___ 2. Periodic, and planned maintenance actions taken to maintain a piece of equipment within design operating conditions and extend its life.	b. Maintenance
___ 3. Activities performed prior to equipment failure. The activities can be initiated by predictive or periodic maintenance results, by vendor recommendations, or by experience.	c. Corrective
___ 4. Activities involving continuous or periodic monitoring and diagnosis to forecast equipment failure.	d. Reliability Centered
	e. Preventive
	f. Predictive

- i. Describe the purpose, use, and content of a master equipment list. (K&S 1.26-1.e)

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- j. What factors should be taken into account when planning the frequency of a preventive maintenance activity? (K&S 1.26-1.f)

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- k. What factors should be taken into account when reviewing the planning of a contractor preventive maintenance activity? (K&S 1.26-1.f)

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- l. Describe the scope a post-maintenance testing program. (K&S 1.26-1.g)

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- m. List the equipment, systems, or activities that a post-maintenance testing program should involve. (K&S 1.26-1.g)
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- n. Describe the conditions under which post-maintenance testing should occur. (K&S 1.26-1.g)
- o. Discuss the purpose, use, and contents of maintenance procedures. (K&S 1.26-1.h)

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p. Discuss the development, including human factor considerations of maintenance procedures.

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q. Discuss the verification of maintenance procedures. (K&S 1.26-1.h)

r. Discuss the validation of maintenance procedures. (K&S 1.26-1.h)

s. Discuss the approval of maintenance procedures. (K&S 1.26-1.h)

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- t. Discuss the use of maintenance procedures including actions taken when procedures cannot be followed as written or when unexpected results occur.(K&S 1.26-1.h)

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- u. Explain the purpose of a Facility Condition and Housekeeping Program. (K&S 1.26-1.i)

- v. Discuss the elements of an effective inspection program. (K&S 1.26-1.j)

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w. Describe indicators of good facility conditions and housekeeping standards. (K&S 1.26-1.j)

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- x. Discuss the elements of an effective procedure addressing facility condition inspections. (K&S 1.26-1.j)
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- y. What is the benefit of having key individuals accompany the managers and supervisors during their inspections? (K&S 1.26-1.j)

- z. Once a deficiency is identified by an inspector, in addition to recording the deficiency what should the inspector investigate? (K&S 1.26-1.j)

- aa. Describe the elements of routine inspections. (K&S 1.26-1.j)

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- ab. Describe the relationship between configuration control and maintenance work control process and the maintenance history file. (K&S 1.26-1.k)

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ac. Explain the intent of a Maintenance Problem Analysis Program. (K&S 1.26-1.l)

ad. Discuss the importance of management's involvement in maintenance. (K&S 1.26-1.m)

ae. Discuss the role and responsibilities of maintenance managers. (K&S 1.26-1.m)

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ag. What is the purpose of frequent non-scheduled individual tours of work areas both on- and off-shift by management? (K&S 1.26-1.m)

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ah. In addition to first-hand observations, what other information can maintenance managers use to determine the status of maintenance operations and facilities? (K&S 1.26-1.m)

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ai. What should be used to determine the calibration frequency of M&TE? (K&S 1.26-1.n)

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aj. What is the name of the general type of test performed on an M&TE instrument in the field before and after it is used in the field? (K&S 1.26-1.n)

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- ak. Describe the four-to-one rule regarding the calibration of instruments. (K&S 1.26-1.n)
- al. As part of an exercise for this section, conduct a Maintenance Problem Analysis of a site or equipment specific maintenance problem. Discuss the findings and recommended corrective actions, where appropriate, with your supervisor. (K&S 1.26-1.l)
- am. As part of an exercise for this section, conduct an assessment of a maintenance activity. Discuss the findings and recommended corrective actions, where appropriate, with your supervisor. (K&S 1.26-1.o)

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5. Practice Exercise Answers

- a. Within the Department of Energy, who is responsible to review the maintenance backlog and establish plans to ensure the backlog remains consistent with DOE goals and objectives? (K&S 1.26-1.a)

Managers of Field Elements

- b. What guidance should field element managers, contractor managers, and staff members use for oversight of facility programs supporting maintenance? (K&S 1.26-1.a)

DOE Order 4330.4B should be used to assess the effectiveness and adequacy of contractor policies, procedures, and facility actions in the area of maintenance. Groups reviewing nuclear facility maintenance performance could use this document as a reference to support some aspects of their activities.

- c. What are the eleven (11) items that should be considered to perform an observation? (K&S 1.26-1.b)

- Selecting the activity
- Standards of performance
- Preparing for the observation
- Conducting the observation
- Interacting with personnel
- Attention to important items
- Note-taking
- Understanding what you are seeing, asking questions
- Observing beyond the activity, looking for causes by asking "Why?"
- Documenting the observation
- Follow-up

- d. In preparing for and conducting observations, what actions can assist the evaluator in data collection with field notes. (K&S 1.26-1.b)

- be familiar with the anticipated operations, review documentation and procedures before the observation.
- be familiar with the guidelines of the topic being evaluated and use the guidelines as an expectation baseline.
- pay close attention to ensure every detail is taken in and recorded
- follow your intuition. If something does not look right or seem right, check further. Assume your intuition is correct until your research proves otherwise.
- take copious notes. this will make it easier to follow up on your observation.
- data gathered from observations being performed should be verified and cross checked by the following methods:
 - observe the same operation being performed by different personnel,

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- observe different operations on the same shift, or
- observe different shifts performing similar operations.

e. What is the importance of note taking? (K&S 1.26-1.b)

Since the burden of proof is placed on the evaluator, ample evidence must be gathered to support the conclusion.

f. What information should be included in evaluator notes? (K&S 1.26-1.b)

Time (including month, day, year, and hour); identities (including number, model, revision, name, title); objective evidence quality; relationship to governing documents or criteria; and relationship to process, activity, or product.

The evaluator should remember it is easier to dispose of excess notes than to reconstruct objective evidence from insufficient notes.

g. Explain the intent of the DOE Order 4330.4B, Maintenance Management Program. (K&S 1.26-1.c)

The purpose of DOE Order 4330.4B, Maintenance Management Program, is to provide a general policy and objectives for the establishment of programs for the management and performance of cost effective maintenance and repair of Department of Energy property.

Maintenance management is the administration of a program utilizing concepts such as planning, procedures, schedules, cost control, and evaluation for the effective performance and control of maintenance, with adequate provisions for interfaces with other concerned disciplines such as health, safety, environmental compliance, quality control, and security.

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- h. Match the definition in column A with the term in column B. Use the column B answers one time only. Ignore any response in column B not identified in column A. (K&S 1.26-1.d)

Column A	Column B
c 1. The repair of failed or malfunctioning equipment, system, or facilities to restore the intended function or design condition. This maintenance does not result in significant extension of expected useful life.	a. Planned
	b. Maintenance
	c. Corrective
e 2. Periodic, and planned maintenance actions taken to maintain a piece of equipment within design operating conditions and extend its life.	d. Reliability Centered
	e. Preventive
a 3. Activities performed prior to equipment failure. The activities can be initiated by predictive or periodic maintenance results, by vendor recommendations, or by experience.	f. Predictive
f 4. Activities involving continuous or periodic monitoring and diagnosis to forecast equipment failure.	

- i. Describe the purpose, use, and content of a master equipment list. (K&S 1.26-1.e)

The master equipment list is a compilation of equipment, components, and structures including special tools and equipment used in selecting and scheduling preventive maintenance and assisting in the evaluation of the maintenance program. The list should include both safety related and non-safety related systems and components. This list may sometimes be referred to as the master equipment data base. The master list should be adjusted as dictated by experience, cost-effectiveness, and maintenance history records of equipment performance. The following should be considered for selecting equipment to be included in the program:

- equipment affecting personnel safety
- equipment affecting safe and reliable plant operation
- equipment specified in code, regulatory, or technical safety requirements

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- j. What factors should be taken into account when planning the frequency of a preventive maintenance activity? (K&S 1.26-1.f)
- regulatory and code requirements;
 - vendor recommendations;
 - experience at this and similar facilities;
 - maintenance history;
 - engineering judgement;
 - cost/benefit engineering;
 - available personnel;
 - minimizing personnel radiation exposure using ALARA principles;
 - function, ease of replacement, and demonstrated reliability of equipment or system;
 - optimizing equipment or system availability during unit operating conditions; and
 - operating history.
- k. What factors should be taken into account when reviewing the planning of a contractor preventive maintenance activity? (K&S 1.26-1.f)
- the complexity of the job will require different levels of planning;
 - definition of the problem and identification of the work scope;
 - identification and review of procedures, drawings, vendor manuals, and maintenance history;
 - identification of needed and available data for use in analysis of maintenance problems;
 - procurement of necessary repair parts, materials, tools, and equipment;
 - assessment of staffing and skill requirements for facility, non-facility, and subcontractor personnel;
 - identification and review of resources including other tasks scheduled to occur in the immediate area during the same time period;
 - pre-job ALARA planning;
 - identification of initial conditions and prerequisites, including applicable technical specifications and limiting conditions of operation;
 - identification of quality control inspection, code, and technical specification requirements;
 - establishment of equipment restoration and post-maintenance inspection or testing requirements; and
 - review of work instructions or work package completeness.
- l. Describe the scope a post-maintenance testing program. (K&S 1.26-1.g)
- The scope of post-maintenance testing should be based on the extent of the preventive or corrective maintenance performed on the component.

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- m. List the equipment, systems, or activities that a post-maintenance testing program should involve. (K&S 1.26-1.g)

Post maintenance testing should be accomplished on equipment, systems, or activities such as the following:

- maintenance that affects the integrity or operation of a liquid or gas system
- maintenance that affects mechanical strength of components or fittings
- equipment that is included in special programs such as the in-service inspection and environmental qualification programs
- maintenance that affects or removes design-approved radiation shielding
- electrical distribution equipment such as breakers, bus work, or high-voltage connections
- electrical control circuitry such as protection relays, limit switches, or permissive relays
- electronic components such as controllers, circuit cards, and transmitters
- instrumentation and instrumentation loops
- Health Physics and chemistry instrumentation
- Measuring and test equipment (M&TE)
- Temporary systems that have been installed as substitutes for normally operational systems or portions of systems

- n. Describe the conditions under which post-maintenance testing should occur. (K&S 1.26-1.g)

Test should be performed under conditions that represent normal operating conditions, such as flow, differential pressure, temperature, input signals values, and fluid types. In some cases testing should be performed under conditions that replicate emergency or abnormal conditions the component is expected to operate under.

Test should be conducted in accordance with the approved written post maintenance test or procedures. The documentation should provide measure performance and allow for the documentation and review of test data.

- o. Discuss the purpose, use, and contents of maintenance procedures. (K&S 1.26-1.h)

Maintenance procedure and other work-related documents (e.g., drawings and instructions) should be prepared and used to provide appropriate work direction and to ensure that maintenance is performed safely and efficiently. One of the key elements needed to consistently perform maintenance in a safe and efficient manner is the proper use of written procedures. A balanced combination of written guidance, craft skills, and worksite supervision is required to achieve the quality workmanship essential to safe and reliable facility operation.

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- p. Discuss the development, including human factor considerations of maintenance procedures.

Maintenance procedures must be written for the craft person and should include the following:

- Procedure identification and status (titling or numbering, location, and page and revision identification)
- procedure purpose and scope
- consistent format (for organization, instruction step format, instruction step designation, caution and note format, and page format)
- clearly understood text, using standard grammar and punctuation
 - appropriate level of detail
 - concise instruction steps in logical sequence
 - proper agreement of multiple verb objects
 - specific nomenclature
 - quantitative and compatible values
 - referencing and branching methods
 - coordination of multiple actions
 - warning and caution location
 - effective formatting
 - and clear table, graph, and data sheet layout
- consistent use of illustrations (e.g., preparation, compatibility, views, level of detail, legibility when reproduced)
- clear indication of steps that could initiate an equipment trip or transient or the initiation or interruption of any process action
- clear indication of hold points, independent verification requirements, or data to be recorded
- systematic facility and system prerequisites, precautions, and limitations, required special tools and materials, and required personnel
- clear indication of acceptance criteria, follow-on steps, and restoration instructions
- steps that inform operations personnel of expected alarms or equipment operations
- guidance to craft personnel to notify the operations organization of maintenance that cannot be completed as originally planned or will be delayed and extended past the anticipated schedule and/or across shift changes
- procedure development and preparation using personal computer desktop publishing and computer-aided writing programs.

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- q. Discuss the verification of maintenance procedures. (K&S 1.26-1.h)

Verification is a review to ensure the proper format and technical accuracy of a new or revised procedure. This review should ensure that the format incorporates human-factors principles and other appropriate administrative policies. The technical accuracy review should also include a review of the procedure against the design requirements for that system or component.

Verification should be conducted by one or more reviewers who were not involved in writing the procedure. Other disciplines such as health physics and operations should be considered for the review process.

- r. Discuss the validation of maintenance procedures. (K&S 1.26-1.h)

Validation is a review of a procedure to ensure its usability and correctness. This validates that the procedure provides sufficient and understandable guidance and direction to the craft person and that the procedure is compatible with the equipment or system being maintained.

Validation may be conducted in a shop, in a training environment, on a mockup or simulator, or in some cases by the craft person and supervisor during the first use of the procedure.

- s. Discuss the approval of maintenance procedures. (K&S 1.26-1.h)

Approval should be consistent with facility technical specifications or their equivalent and administrative procedures. As a minimum, the maintenance manager or designee should approve maintenance procedures.

- t. Discuss the use of maintenance procedures including actions taken when procedures cannot be followed as written or when unexpected results occur.(K&S 1.26-1.h)

Procedure compliance requirements should be clearly stated in the procedure or provided as general administrative guidance and should be thoroughly understood by facility personnel. Compliance requirements may vary considerably, depending on the proficiency of the craft person and the potential impact of the maintenance being performed on safety, reliability, and continuity of operation. Managers and supervisors should require and enforce procedural compliance requirements established by facility administrative controls. Normally, two levels of compliance are defined:

- Step-by-step compliance without deviation (such compliance is normally expected for maintenance on safety equipment, for equipment important to facility reliability, and for any activity that could result in a transient or facility shutdown).
- General intent compliance(the experience judgement of the craft person or supervisor is exercised to carry out the maintenance).

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Other compliance categories and definitions may be used, such as identifying a group of steps that may be performed out of sequence. Procedures or portions of procedures required to be in hand and reviewed step by step when performing maintenance should be clearly identified.

Procedure users should understand the need to use procedures with forethought and good judgement, even when step-by-step compliance is not required. Procedure users should question and seek resolution for any situation that, in their judgement, warrants supervisory assistance. Supervisors or managers should resolve such inquiries in a timely manner.

Maintenance and, if appropriate, operations supervisors should be notified immediately when a procedure cannot be followed as written or unexpected results occur. In these instances, work should be stopped with the equipment or system restored to a safe condition. Procedures may need to be changed or revised in accordance with approved administrative procedures.

- u. Explain the purpose of a Facility Condition and Housekeeping Program. (K&S 1.26-1.i)

The involvement of facility managers and supervisors in periodic facility walkdowns and inspections clearly displays management standards to all personnel and can significantly improve the condition of the facility. A program for identification and dispositioning of facility condition deficiencies and housekeeping discrepancies is an important step in maintaining facilities and equipment in a condition of maximum safety reliability and availability.

The appearance and proper functioning of facility systems and equipment are key indicators of a well-maintained and operated facility. Good facility condition, cleanliness, and housekeeping can be established and maintained by knowledgeable individuals who are alert to deficiencies when they are in the facility and take prompt corrective action. Additionally, there needs to be a periodic focused inspection effort to assist in effective identification and correction of facility deficiencies.

Maintaining system and equipment within design conditions results in benefits such as minimizing fluid leakage, minimizing control room alarms caused by malfunctioning equipment, and maintaining equipment environmental integrity. Another benefit of good facility condition and housekeeping is easier access for operations and maintenance by reducing sources and spread of radioactive contamination.

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v. Discuss the elements of an effective inspection program. (K&S 1.26-1.j)

The following elements should be included in the inspection program:

- Facility managers should set high facility condition and house keeping standards and communicate them to all personnel to provide a clear understanding of these standards.
- Appropriate personnel should receive inspection techniques training.
- Facility managers and supervisors should personally participate in inspections.
- Inspection areas should be assigned such that the entire facility is periodically inspected, including areas with difficult access (e.g., high radiation areas and locked areas).
- An inspection coordinator should be assigned to implement, schedule, and monitor the effectiveness of the inspection program.
- Identified deficiencies should be reported and corrected in a timely manner so that personnel can see the positive results of the inspection program.
- Instructions could be prepared to establish the program and define responsibilities for conducting inspections, correcting deficiencies, and accomplishing other tasks associated with the program, such as on-the-spot correction of minor deficiencies. The instructions should clearly define:
 - what is considered a minor deficiency
 - who is allowed to correct them
 - the limitations and documentation associated with the deficiency.
- Inspection guidelines and criteria could be prepared to assist the assigned inspectors in performing their inspections.

w. Describe indicators of good facility conditions and housekeeping standards. (K&S 1.26-1.j)

Setting standards involves establishing an atmosphere of proper work ethics, positive attitudes, and specific expectations by management that are realistic, within the capabilities of the staff, and that are consistent with sound engineering judgement and good economic practice. Standards must be communicated effectively to all personnel so that they are clearly understood. Adherence to these standards should be accessed by facility managers and supervisors through the conduct of routine inspections. Some indicators of good facility condition and housekeeping standards are as follows:

- Rotating equipment is operating in accordance with design specifications.
- Equipment is properly serviced.
- Fluid system integrity is maintained.
- Temporary repairs are recorded and controlled by the facility temporary modification program.
- Instruments and gauges are operational, calibrated, on scale, and indicating values representative of the existing system and equipment conditions.
- Energized electrical equipment and electronic equipment is operable, supplied from normal power sources, and protected from adverse environmental effects such as

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leaks and overheating.

- Protective cabinet doors and electrical enclosure covers are installed to maintain design integrity.
- Equipment and systems are insulated to control heat transfer to or from the environment, to control ambient noise levels, and to promote personnel safety.
- Facility equipment and systems subject to corrosion are protected with a preservative to minimize corrosion.
- Temporary environmental protection is provided, where appropriate.
- Industrial safety and radiological hazards are minimized.
- Walkway and equipment access is maintained.
- Equipment is clean.
- Facility areas, rooms, and grounds are maintained in a clean and orderly condition, including the storage of tools and materials.
- Coatings or covering used to seal walls and floors in potentially contaminated areas are in good condition and assist in controlling contamination.
- Unauthorized modifications or changes to the facility do not exist.
- Illumination of areas, rooms, and grounds is maintained in a manner that provides sufficient light to perform inspections and minor maintenance.

- x. Discuss the elements of an effective procedure addressing facility condition inspections. (K&S 1.26-1.j)

Administrative procedures that describe the inspection program should define:

- expected standards
- provide for documentation of deficiencies
- provide for a means to follow up on deficiency corrective actions
- assign responsibilities for program implementation
- establish a means to measure program effectiveness.

Facility inspection implementing procedures could be incorporated into preventive maintenance or surveillance programs in a manner similar to other visual inspections such as housekeeping inspections. Deficiencies identified during the inspection should be documented by the inspector. Checklists of equipment to be inspected and types of problems to look for could be useful as guides for inspectors.

- y. What is the benefit of having key individuals accompany the managers and supervisors during their inspections? (K&S 1.26-1.j)

Discussions during the inspection should improve inspection techniques and convey the expected standards for facility condition and housekeeping.

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- z. Once a deficiency is identified by an inspector, in addition to recording the deficiency what should the inspector investigate? (K&S 1.26-1.j)

The inspector should look closer and attempt to determine:

- the source or cause
- how long it has existed
- if the deficiency has been previously identified.

- aa. Describe the elements of routine inspections. (K&S 1.26-1.j)

Routine inspections should include the following elements:

- Limit the size of inspection areas so that they are small enough to be thoroughly inspected in the time allotted.
- Schedule each facility area for periodic inspection.
- Periodically rotate inspectors through the various inspection areas.

- ab. Describe the relationship between configuration control and maintenance work control process and the maintenance history file. (K&S 1.26-1.k)

Guide for Operational Configuration Management Program (DOE-STD-1073-93-Pt.1), cites DOE 4330.4A. The Maintenance Management Program establishes DOE expectations regarding the conduct of maintenance activities on various equipment, including repairable or replaceable equipment and non-replaceable facility life-limiting equipment, at both DOE nuclear and non-nuclear facilities. The maintenance activities are designed to provide assurance that the physical configuration is maintained within its design requirements. DOE 4330.4B includes DOE policy that directly relates to material condition and aging management: "Structures, systems, and components that are important to safe operation shall be subject to a maintenance program in order to meet or exceed their design requirements throughout their life." (DOE Order 4330.4B §7.b p.3)

DOE 4330.4B does not provide technical guidance on how the measurement are to be established or how degradation is to be forecasted. Configuration Management (CM) program has an adjunct program, Material Condition and Aging (MCA) Management, that develops analytical methods and testing techniques that can be used to meet the requirements of the maintenance program.

The Configuration Management (CM) program also interfaces with the Maintenance Management program through the change control and document control elements, which address the control of hardware and procedure changes. Within the maintenance program, the main interface is with the work control process (§ 3.4 page I-17 and ¶ 8.3 page II-46), which manages and sequences maintenance activities in the field. Another important interface exists between preventive and predictive maintenance activities and the performance monitoring function of the assessment element of the Configuration Management program.

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- ac. Explain the intent of a Maintenance Problem Analysis Program. (K&S 1.26-1.l)

Systematic analysis should be used to determine and correct the root causes of unplanned occurrences related to maintenance. Maintenance management (§ 16) provides guidance for collecting and trending maintenance history for recurring or persistent equipment failures that should be reviewed by the analysis program. Incident reports, post-trip reviews, and other similar operating experience methods supplement the maintenance history program and provide data, including human error data, which should be reviewed by the analysis program.

An analysis program may be used effectively to reduce recurring maintenance problems by identifying and resolving root causes of the problem.

- ad. Discuss the importance of management's involvement in maintenance. (K&S 1.26-1.m)

Direct observation and immediate feedback by managers, especially managers several levels above first-line supervisors, may bolster the craft person's pride in his/her work. This can result in fewer errors, higher standards, and improved morale.

Managers should motivate first-line maintenance supervisors to observe the activities of craft personnel in the field by setting an example.

Frequent tours of the facility assists the maintenance managers become involved and understand the activities taking place in the facilities.

- ae. Discuss the role and responsibilities of maintenance managers. (K&S 1.26-1.m)

Managers should be sufficiently involved with facility operations to be technically informed and personally familiar with the conditions at the operating facility to ensure the safety of DOE nuclear facility operations.

Managers should visit the facility, including visits at irregular hours, assess selected activities and portions of the facility, and leave a written record of their observations.

Managers should periodically review the maintenance program to verify that they are effectively accomplishing the intended objectives and the programs are upgraded as needed

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af. Identify examples of work practices that should be reviewed and verified by maintenance managers. (K&S 1.26-1.m)

- safety is the first priority for all work, ensure unsafe conditions and deficiencies are clearly identified
- industrial safety and radiological protection practices
- exposure of personnel to hazardous materials and conditions is minimized
- the potential for the spread of radioactive or other hazardous materials is minimized through proper containment and handling
- proper use of pre-job briefings and applicable training
- quality of workmanship, materials, and parts
- work being performed on the correct structures, systems, and components (SSC)
- applicable authorization, procedures, documents, permits are available at the job site
- individuals performing work or responsible for work are adequately trained and have a clear understanding of work scope and the effect of the work being performed
- the purpose and importance of plant structures, systems, and components (SSC)
- general facility layout (including emergency egress routes and assembly locations)
- maintenance activities are under the control of the applicable owner/operator
- maintenance personnel exhibit an attitude of first-effort quality workmanship
- the concept of ALARA includes "value-added" considerations when planning work to minimize potential exposure
- maintenance personnel are:
 - attentive to identifying deficiencies and off-normal conditions and bringing them to the attention of applicable managers
 - responsive to priority correction of deficiencies and off-normal conditions when approved by applicable managers
- environmental protection/regulations
- proper handling and storage of hazardous materials and waste minimization
- procedure use, including adherence to step-by-step requirements, sign-offs, and work hold points
- open system and component protection (foreign material exclusion)
- accountability of tools, chemicals, and materials
- use of proper tools for the proper job
- work progress and time required to perform the job, especially in a Limiting Condition for Operation exists
- operations and support organizations involvement is coordinated into applicable activities
- effective trouble shooting techniques

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- by-passing or deactivation of safety controls, interlocks, and structures, systems, and components (SSC) for test purposes, calibration/certification, or maintenance is performed in accordance with detailed, approved procedures and permits
 - the requirements and conditions for restoring structures, systems, and components (SSC) to service following deactivation or by-passing is documented and verified
 - post maintenance testing instructions should be clearly defined, understood, and include the following:
 - clearly written instructions
 - specific parameter acceptance criteria
 - applicable test precautions and safety considerations
 - a test scope adequate to verify the adequacy of completed work
 - documentation of test results/data
 - test results review and written acceptance by operations
 - proper use of post-job reporting and when applicable post-job critiques
 - backlog is effectively managed

ag. What is the purpose of frequent non-scheduled individual tours of work areas both on- and off-shift by management? (K&S 1.26-1.m)

Tours provides:

- first-hand observation of actual conditions
- an opportunity to communicate expected performance standards through appropriate and timely recognition/feedback directly to individuals regarding either positive or negative observations
- an opportunity to seek involvement in and to established ownership of approved actions at the level closest to and directly involved in performance improvement
- incentive for individuals at all levels to take pride in their accomplishments
- motivation for first-line supervisors and craftspersons to accept responsibility for the early detection of opportunities for improvement
- the means for timely escalation of significant problems/concerns to the level of management having resolution authority

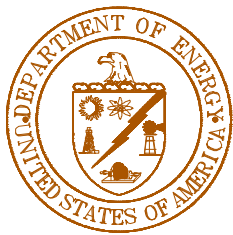
ah. In addition to first-hand observations, what other information can maintenance managers use to determine the status of maintenance operations and facilities? (K&S 1.26-1.m)

- key performance indicator trend reviews
- critical self-assessments
- exception reports
- problem and corrective action status tracking
- Lessons Learned and Alert System reviews
- daily and weekly review of staff activities
- customer feedback
- craftsperson input

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- historical data
 - regulatory Environment, Safety, and Health (ESH) requirements
- ai. What should be used to determine the calibration frequency of M&TE? (K&S 1.26-1.n)
- Calibration frequency should be determined based:
- on the manufacturer's recommendations
 - M&TE usage
 - M&TE historical reliability
 - consideration should be given to the amount and type of M&TE available for use compared to the M&TE needed to support peak activity periods such as outages
- aj. What is the name of the general type of test performed on an M&TE instrument in the field before and after it is used in the field? (K&S 1.26-1.n)
- Operational tests, functional check, or battery check.
- ak. Describe the four-to-one rule regarding the calibration of instruments. (K&S 1.26-1.n)
- Reference standards used to calibrate M&TE shall have a minimum accuracy four times greater than the M&TE being calibrated. The accuracy requirement is satisfied when the M&TE is calibrated by a reference standard with a minimum 4:1 higher accuracy ratio. The reference standard must also be traceable through a series of calibrations using reference standards also of 4:1 greater accuracy, back to the National Institute of Standards and Technology (NIST) or other appropriate governing laboratory standard.
- al. As part of an exercise for this section, conduct a Maintenance Problem Analysis of a site or equipment specific maintenance problem. Discuss the findings and recommended corrective actions, where appropriate, with your supervisor. (K&S 1.26-1.1)
- am. As part of an exercise for this section, conduct an assessment of a maintenance activity. Discuss the findings and recommended corrective actions, where appropriate, with your supervisor. (K&S 1.26-1.o)

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Glossary

Appendix A

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Appendix A Glossary

Acronyms used in this document:

ALARA	As Low As Reasonably Achievable	IST	In Service Testing
ANSI	American National Standards Institute	LCO	Limiting Conditions of Operation
ASME	American Society of Mechanical Engineers	LCP	Life Cycle Plan
CAMP	Capital Asset Management Process	LTA	Logic tree analysis
CAIS	Condition Assessment Information System	M&TE	Measuring and Test Equipment
CAS	Condition Assessment Survey	MCA	Material Condition and Aging Management
CM	Configuration Management	MEL	Master Equipment List
DOE	Department of Energy	MIG	Maintenance Importance Generator
DOELLIS	Department of Energy Lessons Learned Information Services	MIP	Maintenance Implementation Plans
EQ	Environmental Qualifications	MJR	Maintenance Job Request
ESH	Environment, Safety, and Health	MSDS	Material Safety Data Sheet
IEEE	Institute of Electrical and Electronic Engineers	NIST	National Institute of Standards and Technology
INPO	Institute of Nuclear Power Operations	NRC	Nuclear Regulatory Commission
ISI	In Service Inspection	OEAF	Office of Operating Experience Analysis and Feedback
		ORPS	Occurrence Reporting and Processing System

PI	Performance Indicator	RECID	Record Identification
PM	Preventive Maintenance	RIDS	Records Inventory and Disposition Schedules
PMT	Post Maintenance Testing	RWP	Radiation Work Permit
QAP	Quality Assurance Program	SSC	Structures, Systems, and Components
QC	Quality Control		
RCA	Radiologically Controlled Area	SWP	Safe Work Permit
RCM	Reliability Centered Maintenance		

As-Built Documentation (for example, Piping and Instrument Diagrams, and database records) verified by physical inspection as depicting the actual physical configuration and verified as consistent with the design requirement.

Acceptance Tag The final receipt inspection identifier affixed to an item prior to placing the item in storage. It indicates all purchase requirements have been met.

Assessment For engineering applications, the process of estimating the value of something using authoritative expert judgement based upon observations of representative cases and rough calculations, rather than determining the exact value based upon comprehensive and detailed examinations, and precise and rigorous complete calculations.

Condition Any as-found state, whether or not resulting from an event, which may have adverse safety, health, quality assurance, security, operational, or environmental implications. A condition is more programmatic in nature, for example, an error in analysis or calculation; an anomaly associated with design or performance; or, an item indicating a weakness in the management process are all conditions.

Configuration Management	An integrated management program that establishes consistency among design requirements, physical configuration, and facility documentation, and maintain this consistency throughout the life of the facility as changes occur. The configuration management (CM) program consists of CM requirements, document control, change control, and assessment. The CM program also includes design reconstitution and material condition and aging management (MCA) as adjunct programs.
Corrective Maintenance	The repair and restoration of failed or malfunctioning equipment, system, or facilities to restore the intended function or design condition. This maintenance does not result in significant extension of expected useful life. As a rule of thumb, if the specific component requiring maintenance has failed, the action required to repair it should be classified as corrective maintenance.
Deficiency	Any condition that deviates from the design of a structure, system, or component and results in a degraded ability to accomplish its intended function.
Discrepancy	Those open items that are determined to have safety significance.
Documented PMT	Rigorous, formal documentation of post maintenance testing required, when specified by the equipment owner.
Equipment Failure	A condition in which equipment can no longer perform its design requirements. Failure may be random or the results of progressive aging.
Event	A real-time occurrence (e.g., pipe break, valve failure, loss of power, etc.)

Graded Approach	<p>A process by which the level of analysis, documentation, and actions necessary to comply with a requirement in the Order are commensurate with:</p> <ol style="list-style-type: none">(1) The relative importance to safety, safeguards, and security;(2) The magnitude of any hazard involved;(3) The life cycle stage of a facility;(4) The programmatic mission of a facility;(5) The particular characteristics of a facility; and(6) Any other relevant factor. <p>(10CFR830.3 1995)(DOE Order 4330.4B 2-10-94)</p> <p>The depth of detail required and the magnitude of resources expended for a particular management element to be tailored to be commensurate with:</p> <ul style="list-style-type: none">• the element's relative importance to safety, environmental compliance, safeguards and security,• programmatic importance,• magnitude of the hazard,• financial impact, and/or• other facility-specific requirements. <p>(DOE Order 430.1 8-24-95)</p>
Hazard	<p>A source of danger (i.e., material, energy source, or operation) with the potential to cause illness, injury, or death to personnel or damage to a facility or environment (without regard to the likelihood or credibility of accident scenarios or consequential mitigation).</p>
Housekeeping	<p>The cleaning and preservation of the facility, its systems, and components. Also used to refer to the condition of facility cleanliness, orderliness, and preservation.</p>
Item	<p>Any spare part, consumable, equipment, or material. May include entire component, valve, motor, instrument, gasket, adhesive, seal, etc.</p>
Laydown Area	<p>Area on or close to a job site, designated and approved by the facility owner, to be used by maintenance personnel for the materials and equipment used on the maintenance job, for the duration of the job.</p>

Lesson Learned	Any experience, example, observation, or insight that imparts wisdom and/or beneficial knowledge to an employee during conduct of the technical, procedural, business, legal, or administrative tasks associated with the design, development, fabrication, operation, and/or test of any product or service.
Life Cycle	The life of an asset from planning through acquisition, maintenance, operation, and disposition.
Life Limiting Component	A structure, system, or component whose failure could result in termination of facility operations.
Maintenance	Day-to-day work that is required to sustain, maintain, and preserve property, plant equipment, and capital equipment in a condition suitable for it to be used for its designated purpose and includes preventive, predictive, and corrective (repair) maintenance.
Maintenance backlog	The amount of maintenance and repair work not accomplished that is needed or planned to sustain the assigned mission.
Master Equipment List (MEL)	A detailed master list of plant structures, systems, and components (SSC) to be included in the maintenance program. The list should include both safety related and non-safety related systems and components. This list may sometimes be referred to as the master equipment data base.
Measuring and Test Equipment (M&TE)	M&TE includes all devices or systems used to calibrate, certify, measure, gauge, troubleshoot, test, or inspect in order to control data or acquire data to verify conformance to specified requirements. M&TE does not include permanently installed plant instrumentation, nor does it include test equipment used for preliminary checks where data obtained is not used to determine acceptability or verify conformance to established criteria.

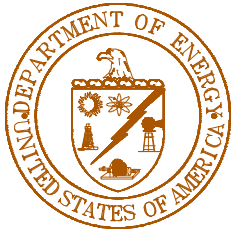
Occurrence	Any deviation from the planned or expected behavior or course of events in connect with any Department of Energy or Department of Energy controlled operation if the deviation has environmental protection, safety, or health protection significance.
Occurrence Report	A written evaluation of an event or condition that is prepared in sufficient detail to enable the reader to assess its significance, consequences, or implications and to evaluate the actions being proposed or employed to correct the condition or to avoid reoccurrence.
Outage	Condition existing whenever normal operations has stopped, due to planned or unplanned occurrences.
Performance Indicators	Operational information which is indicative of the performance or condition of a facility, group of facilities, or site.
Periodic Maintenance	Preventive maintenance activities accomplished on a routine basis (typically bases on operating hours or calendar time) and may include any combination of external inspections, alignments or calibrations, internal inspections, overhauls, and Structures, Systems, and Components (SSC) replacements.
Planned Maintenance	Maintenance activities performed prior to equipment, structure, system, or component failure. The activities can be initiated by predictive or periodic maintenance results, by vendor recommendations, or by experience/lessons learned.
Post Maintenance Test	<p>Any appropriate testing performed following maintenance to verify that a particular piece of equipment or system performs its intended function based on its design criteria and that the original deficiency has been corrected and there are no new deficiencies created. Documented post maintenance testing or standard checkout and verification, performed following maintenance, which proves that the equipment is operable as designed and confirms the following:</p> <ul style="list-style-type: none">• The original deficiency has been corrected.• No new deficiencies have been created.• The equipment is ready to return to service.

Predictive Maintenance	Maintenance activities involving continuous or periodic monitoring and diagnosis to forecast equipment degradation or failure so that "as-needed" planned maintenance may be performed prior to Structures, Systems, and Components (SSC) failure.
Preventive Maintenance	Predictive, periodic, and planned maintenance actions taken to maintain a piece of equipment, Structures, Systems, and Components (SSC) within design operating conditions, extend its life, and is performed to prevent Structures, Systems, and Components (SSC) failure. This includes technical safety requirements surveillance, in-service inspections, and other regulatory forms of preventive maintenance.
Q-List	An engineered approved listing of safety class structures, systems, and components (SSC).
Recall Program	A system to recall and service measuring and test equipment (M&TE).
Repair	The restoration of failed or malfunctioning equipment, system, or facility to its intended function or design condition. Repair does not result in a significant extension of the expected useful life.
Reliability Centered Maintenance (RCM)	A method for establishing a scheduled maintenance program that can effectively and economically realize the inherent reliability and safety levels of equipment. The program is based on analysis of an item's failure modes, failure rates, and the importance of the item to the safe operation of the facility.
Root Cause	A determination based on analytical techniques that determines the fundamental cause of failure.
Reportable Occurrence	Events or conditions to be reported in accordance with the criteria defined in DOE 5000.3A <u>Occurrence Reporting and Processing of Operations Information</u> .

Shelf Life	A specific period or interval of time after which a stored item may not meet its original design specifications, quality, or manufacture requirements.
Staging Area	Area designated and approved by the maintenance supervisor, for staging parts, material, and supplies until a maintenance job is ready to work.
Structures, Systems, and Components (SSC)	Physical items designed, built, or installed to support the operation of the plant. Structures are elements that provide support or enclosure such as buildings, free standing tanks, basins, dikes, and stacks. Systems are collections of components assembled to perform a function such as piping, cable trays, conduit, or HVAC. Components are items of equipment such as pumps, valves, relays, or elements of a larger array such as software, lengths of pipe, elbow, or reducers.
Surveillance Test	A functional test of installed plant structures, systems, and components (SSC) for periodic monitoring of performance adequacy.
Technical Support	The engineering, design, specialized inspections, planning, or other such support of capital asset maintenance and repair.
Tool Storage Area	Area authorized and controlled for the issuance and storage of tools and equipment designated for use in the facility.
Tools and Equipment	All non-installed items commonly used to perform or assist in maintenance work functions within the facility. These items are not normally designed to perform highly specialized tasks and include such items as hand tools, power tools, electric cords, hoses, chain falls, scaffolding, ladders, and calibrated test equipment.

Troubleshooting	The process of locating and identifying plant structures, systems, and components (SSC) malfunctions through deductive and inductive reasoning and/or testing. The process may include (but is not limited to) activities such as readings, pulling fuses, stroking valves, changing electronic modules, partial or complete disassembly of a component, etc.
Value-added	A decision-making process that leads to an improvement in an operation or process, based on effectiveness, efficiency, cost-effectiveness, safety, etc.

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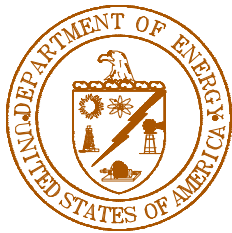
Training-to-Competency
Matrix

Appendix B

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References

Appendix C

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Appendix C References

A. The following references are subject to Change Control¹. Users should reference the most current revision.

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2. DOE Order O 430.1, Life-Cycle Asset Management
3. DOE Order 1324.2A, Records Disposition
4. DOE Order 4320.1B, Site Development Planning
5. DOE Order 4320.2A, Capital Asset Management Process
6. DOE Order 4330.2C, In-house Energy Management
7. DOE Order 4330.4B, Maintenance Management Program
8. DOE Order 5000.3A, Occurrence Reporting and Processing of Operations Information
9. DOE Order 5480.19, Conduct of Operations Requirements for DOE Facilities
10. DOE Order 5480.21, Unreviewed Safety Questions
11. DOE Order 5480.22, Technical Safety Requirements
12. DOE Order 5480.23, Nuclear Safety Analysis Reports
13. DOE Order 5480.26, Trending and Analysis of Operations Information Using Performance Indicators
14. DOE Order 5484.1, Environmental Protection, Safety, & Health Protection Information Reporting Requirements
15. DOE Order 5700.6C, Quality Assurance
16. DOE-HDBK-1003-96, Guide to Good Practices for Training and Qualification of Maintenance Personnel
17. DOE-HDBK-7502-95, Implementing U.S. Department of Energy Lessons Learned Programs
18. Safety Notice 93-02, DOE/EH-0345 September 1993, Control of Temporary Modifications
19. Safety Notice 95-01, DOE/EH-0500, August 1995 Decision Analysis Techniques, Office of Nuclear and Facility Safety
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¹ Change Control is a proceduralized process which ensures all changes are properly executed, from initiation of the change request through the approval, implementation, and incorporation into the next document revision.

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25. DOE-STD-1039-93, Guide to Good Practices for Control of Equipment and System Status
26. DOE-STD-1048-92, DOE Performance Indicators Guidance Document
27. DOE-STD-1050-93, Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities
28. DOE-STD-1051-93, Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities
29. DOE-STD-1052-93, Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities
30. DOE-STD-1053-93, Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities
31. DOE-STD-1054-93, Guideline to Good Practices for Control and Calibration Measuring and Test Equipment (M&TE) at Nuclear Facilities
32. DOE-STD-1055-93, Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities
33. DOE-STD-1063-93, Establishing and Maintaining A Facility Representative Program at DOE Nuclear Facilities
34. DOE-STD-1064-94, Guideline to Good Practices for Seasonal Facility Preservation at DOE Nuclear Facilities
35. DOE-STD-1065-94, Guideline To Good Practices For Post Maintenance Testing At DOE Nuclear Facilities
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37. DOE-STD-1068-94, Guideline To Good Practices For Maintenance History At DOE Nuclear Facilities
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39. DOE-STD-1070-94, Guideline for Evaluation of Nuclear Facility Training Program (not issued)
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48. Office of Nuclear and Facility Safety, Operating Experience Weekly Summaries
49. SR-TA-COA-SSG-01, Conduct of Assessments Topical Area Self Study Guide
50. SR-TA-MNT-SSG-01, Maintenance Management Topical Area Self Study Guide

B. The following references are NOT subject to "Change Control". Users may reference the identified revision or the most current revision. NOTE: if revised edition used pages and chapters may have changed.

1. General Physics Corporation. Applying Reliability Centered Maintenance Seminar and Workshop Student Handbook, Chapter Effective Evaluations.
2. Savannah River Site Lead Assessor/Auditor Training course number QAT115, Student Manual.
3. Savannah River Implementing Procedure (SRIP) 5700.6.12B, SR Technical Assessment Program, Attachment B, Conduct of Field Personnel, or use applicable site documents.
4. Kerzner Ph.D., Harold (1989 Third Edition). Project Management, A Systems Approach to Planning, Scheduling, and Controlling. New York, NY: Van Nostrand Reinhold. ISBN 0-442-20751-4. Call# HD69.P75K47.

C. The following references are NOT cited as a Knowledge and Skill reference but may supply addition information to the reader. Users may reference the identified revision or the most current revision.

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8. Institute of Nuclear Power Operations. Post-Maintenance Testing, INPO 87-028 (Good Practice MA-305). Atlanta, GA: Institute of Nuclear Power Operations.
9. Institute of Nuclear Power Operations. Preventive Maintenance Program Enhancement, INPO 92-014 (MA-319). Atlanta, GA: Institute of Nuclear Power Operations.